The Check-and-Balance Affect on the Relationship between Financing Constraints and Investment Efficiency — Taking the Chinese Software and IT Industry as a Sample

Abstract: This study explores the relationship between the degree of financing constraints and investment efficiency based on the moderator of the checks-and-balances mechanism using the Ordinary Least Square method and Quantile regressions for software and IT service sample industries of the Chinese listed companies from 2017 to 2021. The study finds that for software and IT service industries, the higher the degree of financing constraints, the worse the investment efficiency. Overall, the higher the degree of financing constraints, the greater the separation of powers between the chairman and the managing director, and the greater the checks and balances that can be exercised, resulting in a significant increase in investment efficiency. This is especially true in the very high and very low levels of investment efficiency. However, at any level of investment efficiency, the degree of independent directorship does not have a significant counterbalancing effect between financing constraints and investment efficiency and is even reversed at the average level of overall efficiency. Based on the above findings, this study also proposes corresponding recommendations.

Keywords: check-and-balance mechanism; financing constraint; investment efficiency

1 Introduction

The core concept of governance is to achieve check-and-balance among stakeholders through the separation and check-and-balance of decision-making, executive and supervisory powers, as well as the protection of minority shareholders and outside shareholders (Malenfu et al., 2022). However, it is still heard that listed companies do not function well because of the check-and-balance mechanism. The existence of independent directors is precisely a function of checks and balances in decision-making power, which on the one hand provides professional advice to the company, and on the other hand can check internal directors from making decisions that are harmful to minority and outside shareholders for their own selfish interests. The financial fraud case that occurred at the end of 2012 at Kangmei Corp. was the first case in China in which independent directors were punished, and all board members were individually held accountable, with five of them being sentenced to fines ranging from 123 million Yuan to 246 million Yuan, causing strong reactions from all sectors of society. This not only shows that the responsibility of independent directors is great, but also shows that most of the current independent directors in China are not functioning as they should. In the Announcement No. 14 "Rules for Independent Directors of Listed Companies" issued by the China Securities Regulatory Commission in 2022, it is stated that listed companies should establish an independent director system. It is also clearly stated that in addition to the powers and functions granted to directors under the “ Company Law of the People's Republic of China ” and other relevant laws and regulations, the independent directors are also given special powers and functions to express opinions on material connected transactions, material financial operations and matters that may harm the rights and interests of small and medium shareholders. This means that the independent directors have a check and balance role in the decision-making process of the Board of Directors, so as to prevent the insider directors from acting in their own interest or at their own will to the detriment of the rights and interests of the minority shareholders. However, from the perspective of corporate governance, if the chairman and general manager are combined, it is like a player and a referee, and the function of the board

of directors to supervise the executive level is lost. At present, there is still a large part of domestic listed companies are two positions in one. The board of directors is the highest decision-making unit of the company, holding the right to make decisions on the company's major investments and business directions. If the board of directors operates without a good check and balance mechanism, it may improve the efficiency of its actions, but the risk of decision-making errors may also increase.

As the situation of above, this paper is inspired to explore the role of check-and-balance in the relationship between financing constraints and investment efficiency. Because the company needs more rigorous planning for capital utilization in the case of tight funds, otherwise it will easily lead to the risk of capital chain breakage. The goal of corporate governance is to protect the reasonable return on investment of all shareholders. In order to improve the quality of corporate decision-making and prevent large shareholders from overconfident and selfish behavior, so in the framework of corporate governance, the check-and-balance mechanism is very important. The purpose of this paper is to explore whether the check and balance mechanism is effective in the relationship between the degree of financing constraints and investment efficiency of enterprises, and to help companies make correct decisions and efficient use of funds.

In the past literature, there are studies on this topic, but the findings on corporate governance are not the same due to the cultural differences between different countries and regions; on the other hand, in the reviewed literature, the relationship between check-and-balance, financing constraints and investment efficiency is mostly studied in a two-by-two correlation or by the least squares method; therefore, the innovation of this paper is to investigate the relationship between the three mechanisms. In addition to the least squares (OLS) method, we will also use quantile regression to conduct in-depth analysis. It is expected that the results of the study will provide a basis for optimizing corporate governance in the software industry and help companies in other industries in China to have a better understanding of corporate governance. In the subsequent chapters, we will review the literature and summarize the research hypotheses, design a model and analyze the empirical results, and finally

make recommendations based on the results.

2 Literature review

2.1 Concepts and functions of corporate governance and check-and-balance

Lin et al. (1997) define corporate governance structure as a set of institutional arrangements for owners to monitor and control the management and performance of a firm, and Wartick and Cochran (1985) suggest that corporate governance issues include specific problems arising from the interaction of senior management, shareholders, the board of directors, and other stakeholders in the firm. At the heart of the corporate governance problem are (1) who benefits from corporate decisions and senior management actions and (2) who should benefit from corporate decisions/senior management actions: when there is an inconsistency between "what is" and "what should be. The governance problem of a company arises when there is a disagreement between "what is" and "what should be". Liu and Li (2009) suggest that the core and purpose of corporate governance is to ensure scientific corporate decision making, and mutual checks and balances among stakeholders is one of the ways and means to ensure scientific corporate decision making.

The role of checks and balances mechanism in corporate governance is to make the rights of all parties to be checked and balanced. It mainly includes power check and balance mechanism and equity check and balance mechanism. In the enterprise, in order to hold absolute control and the checks and balances mechanism is not perfect, the major shareholders usually for their own interests to damage the property and interests of small retail shareholders. Therefore, firms can protect the interests of minority shareholders through mechanisms of checks and balances that constrain shareholders; and equity checks and balances can improve the efficiency of corporate governance when firms have excess free cash flows ready for overinvestment and the cost of capital is high; but equity checks and balances may not be a good choice if firms face ample investment opportunities and managers are able to make wise choices (Gomes and Novaes, 1999; Gomes, 2001). According to Zhang et al. (2012), the traditional corporate governance mechanism emphasizes the checks and balances of the various roles within the company, with the company's executives being

appointed by the board of directors and subject to the board's evaluation and supervision; the evaluation of the board's operational efficiency and job performance is checked and balanced by the shareholders' meeting, which is composed of all shareholders. The results of the study by Kong et al. (2016) indicate that in the domestic corporate governance environment, the appropriate introduction of equity checks and balances mechanism is an effective means to improve the performance of listed companies and regulate the internal control system, while the introduction of state-owned checks and balances shareholders can better perform the effectiveness of internal control.

2.2 Introduction to the definition and model of financing constraints

The financing constraint describes the constraints on the firm's external financing. Modigliani and Miller (1958) (MM theory) proposed that under the assumption of perfect and complete capital markets, a firm's investment decisions are independent of its financing decisions, and the firm will consider investing in a project when and only when the net present value of the project's cash flows exceeds the associated capital expenditures. However, in reality, there is no truly perfect capital market, and many uncontrollable problems such as information asymmetry and agency problems can make the cost of external financing higher than the cost of internal funding, and a firm's ability to raise capital always influences investment behavior to a large extent. Several of the more commonly used models are presented below.

2.2.1 KZ index

Kaplan and Zingales (1997) define the financing constraint as the difference between a firm's internal and external financing costs due to issues such as market information asymmetry and agency costs. The model uses a measure of financing constraint in terms of the firm's behavioral characteristics (investment-cash flow sensitivity, cash-cash flow sensitivity) or a linear combination of the firm's financial variables as a measure of financing constraint. The KZ index model is as follows.

$$KZ = -1.001909 * \frac{OCF}{Asset} + 3.139193 * Lev - 39.3678 \frac{Dividends}{Asset} - 1.314759 * \frac{Cash}{Asset} + 0.2826389 * Tobin's\ Q$$

Where OCF, Dividends and Cash are the net operating cash flow, dividend and cash holding levels, respectively, and are normalized by total assets at the beginning of the period, Lev is the gearing ratio, and Tobin's Q is the Tobin's Q value. The higher the value, the higher the financing constraint faced by the firm.

2.2.2 WW index

The WW index is constructed by Whited and Wu (2006) by combining a linear combination of six indicators: dividend payout dummy, cash flow, gearing, firm size, and sales growth rate of the firm and the industry, taking into account not only the firm's own financial characteristics but also the firm's external industry characteristics, which has a broader economic meaning and improves accuracy by excluding Tobin's q. The WW index is calculated by the formula as follow :

$$WW_{i,\ t} = b_1 TLTD_{i,\ t} + b_2 DIVPOS_{i,\ t} + b_3 LNTA_{i,\ t} + b_4 SG_{i,\ t} + b_5 ISG_{i,\ t} + b_6 CF_{i,\ t}$$

Where $TLTD_{i,t}$ is the ratio of long-term liabilities to total assets, $DIVPOS_{i,t}$ is a dummy variable that takes the value of 1 when dividends are paid, $LNTA_{i,\ t}$ is the natural logarithm of total assets, $SG_{i,\ t}$ is the sales growth rate of the firm, $ISG_{i,\ t}$ is the sales growth rate of the industry in which the firm operates, and $CF_{i,\ t}$ is the ratio of cash flow to total assets.

2.2.2 SA 指数

To avoid endogeneity interference, Hadlock and Pierce (2010) follow the KZ method to classify the types of corporate financing constraints based on corporate financial reports, and then apply only two variables, firm size and firm age, which do not vary much with events and are highly exogenous, to construct the SA index. The SA index does not contain financing variables with endogeneity characteristics. The SA index is calculated as

$$SA_{i,\ t} = -0.737 * SIZE_{i,\ t} + 0.043 * SIZE_{i,\ t}^2 - 0.04 * AGE_{i,\ t}$$

2.2.3 Financing constraint evaluation model developed in China

Chinese scholars Zhai et al. (2012) developed a financing constraint degree evaluation model that is more suitable for Chinese enterprises to measure based on a comprehensive consideration of classical evaluation models such as FHP, KZ and WW, and after refining the original variables. The model is.

$$FC_{i,\ t} = -8.530658 * \Delta PR_{i,\ t} - 0.4599886 * SIZE_{i,\ t} - 0.0030249 * SLACK_{i,\ t} - 2.453183 * CF_{i.t}/A_{i,\ t-1} - 1.304857 * SGR_{i,\ t}$$

Where FC represents the degree of financing constraint of the firm, and the larger the absolute value of FC, the smaller the degree of financing constraint. △SIZE represents the size of the company, expressed as the natural logarithm of the company's total assets at the end of the period. SLACK is financial slack, calculated as (cash + trading financial assets + 0.5*inventory + 0.7*receivables-short-term loans)/net fixed assets. SGR is operating income growth ratio = (current year's operating income - last year's operating income) / last year's operating income.

In recent years, CSMAR database has also referred to Fee et al. (2009), Fang et al. (2010), Zhang et al. (2017), Gu et al. (2020), and Chen et al. Therefore, this paper will use the FC index of CSMAR data as a proxy variable for financing constraints.

2.3 Definition of investment efficiency and introduction to the model

Investment efficiency is the ratio of the amount of national income growth to the amount of capital investment that formed this growth. It is a macro indicator to evaluate the efficiency of capital investment from the perspective of national economy. It is equivalent to the coefficient indicator of economic effect of investment in our national economy. When using investment efficiency to measure stock warning and investment efficiency, the greater the investment efficiency, the higher the investment occupancy rate of income. The smaller the investment efficiency, then the lower the investment occupancy rate of national income. The most academically adopted models to measure investment efficiency are: Fazzari et al.'s (1988) FHP model, Vogt's (1994) Vogt model and Richardson's (2006) inefficient investment model. Among them, Richardson's model not only can directly measure the inefficiency of investment, but also has a more reasonable design and easier operation compared with the other two models, so it is widely used by academics. Richardson (2006) efficient

investment model is as follows.

$$INVEST_{it} = \alpha_0 + \alpha_1 GROWTH_{i,\ t-1} + \alpha_2 LEV_{i,\ t-1} + \alpha_3 CASH_{i,\ t-1} + \alpha_4 AGE_{i,\ t-1} + \alpha_5 SIZE_{i,\ t-1} + \alpha_6 RETURNS_{i,\ t-1} + \varepsilon_{it}$$

where INVEST is the current period new investment (normalized by total assets), GROWTH is the growth rate of operating income in the previous period, LEV is the balance sheet ratio in the previous period, CASH is the cash ratio in the previous period, AGE is the number of years listed in the previous period, SIZE is the natural logarithm of the book value of total assets in the previous period, and RETURNS is the annual return on company stock in the previous period. ε is the residual, which is the inefficient investment, represents overinvestment. A value of ε greater than 0 indicates overinvestment and less than 0 indicates underinvestment.

2.4 Literature on the association between checks and balances, financing constraints and investment efficiency

In a study by Huang and Liu (2022) on financialization, financing constraints and investment efficiency of real firms, it is argued that the " crowding out " effect of corporate financialization is diminished when listed firms are subject to higher financing constraints, thus curbing the negative impact of corporate financialization on investment efficiency. This may be due to the fact that firms subject to higher financing constraints have limited sources of replenishment and capital reserves, making managers more concerned about depleting their internally accumulated cash assets and cautiously choosing more valuable investment projects. In his study, Xie (2021) argues that financing constraints are a double-edged sword; for over-invested distribution firms, financing constraints will alleviate redundant investments brought about by excessive management power; for under-invested distribution firms, financing constraints will lead to the loss of good investment opportunities and inhibit the improvement of their investment efficiency; financing constraints are an external barrier that can effectively mitigate redundant investments brought about by management The financing constraint is an external barrier that can effectively alleviate the inefficient investment of distribution firms due to the excessive power of

management. Summarizing the above findings, the following research hypotheses can be inferred.

H1: Financing constraints have a positive and significant effect on investment efficiency.

Both check-and-balance mechanism of equity and power are important in corporate governance and the most important of these checks and balances are the two-position unity and independent director-related studies are reviewed and summarized and research hypotheses are proposed.

1 The combination of two positions of chairman and general manager

The duty of the general manager is to execute the decisions of the board of directors. Zhu and Ding (2016) found that the combination of two positions of general manager and chairman would weaken shareholders' supervision of senior management, thus increasing agency costs and reducing firm performance. Agency theory argues that the two positions should be separated and that the combination of the two positions is not conducive to corporate efficiency and will weaken the supervisory role of the board of directors, which will lead to agency problems (Gu and Bian, 2020). Organizational behavior theory, on the other hand, suggests that the separation of the two positions helps management to make more efficient investment decisions in the company and promotes effective communication within the company to improve the efficiency of the company. The results of Chen and Kuang (2018) show that the two-job unity cannot really play a role in governance; Zhang and Wan (2021), who studied village banks, also concluded that the two-job unity would affect the level of earnings and increase the operational risk. Yu and Wang (2018) studied corporate M&A performance and found that two-job unification showed a significant negative relationship with M&A performance. The study by Wang et al. (2020) indicated that the investment efficiency of two-job-in-one firms is significantly lower than that of two-job-separated firms. Based on the findings of the above literature, the following research hypotheses can be introduced.

H2: Dual-employment has a moderating effect between financing constraints and investment efficiency.

2 Percentage of independent directors

Morck (2004) found that increasing the proportion of independent directors can strengthen the board's supervision of management, restrain management's behavior, and reduce the level of overinvestment in listed companies. Kolasinski et al. (2010) and Ben et al. (2012) also found that independent directors can effectively curb management's overconfidence and optimism, thus improving investment efficiency. In addition, some scholars have also thought about the composition of independent directors and explored the impact of independent directors on corporate investment efficiency in different environments. For example, Chen and Xie (2011), from the perspective of chain director social network, found that the higher the centrality of independent director network, the better the governance role of independent directors and the higher the efficiency of corporate investment. The study by Li et al. (2022) asserts that the higher the proportion of scholarly independent directors, the lower the level of inefficient investment in the firm. In the mechanism test, it is found that scholarly independent directors can reduce underinvestment by alleviating corporate financing constraints, and at the same time curb corporate overinvestment by reducing principal-agent problems and improving the quality of information disclosure.

However, a number of studies have found that independent directors do not play their proper role and value to firms, and Klein (1998) shows that independent directors have difficulty in effectively monitoring management and are prone to opportunistic behavior, leading to overinvestment. Li and Jiang (2008) concluded that there is no significant correlation between independent directors and the level of overinvestment because of the small proportion of independent directors and their lack of independence in China, which cannot influence the investment decisions of listed companies. Liu et al. (2012) concluded that in Chinese listed companies, it is difficult for independent directors to play their own supervisory function and cannot effectively reduce over-investment behavior due to managerial agency problems. From the perspective of heterogeneous independent directors, Lin and Cao (2017) found that heterogeneous independent directors instead contribute to better investment efficiency of companies. Based on the findings of the above literature, the following

research hypotheses can be introduced.

H3: The percentage of independent directors has a moderating effect between financing constraints and investment efficiency.

Synthesizing the above research literature, it can be found that there is a certain influence between financing constraints, checks and balances mechanisms and corporate investment efficiency in corporate governance. This paper will conduct a research design in the following sections to verify the linkage and impact between checks and balances mechanism, financing constraints and investment efficiency.

3 Methodology

Based on the literature review, three research hypotheses are identified: 1) financing constraints have a positive and significant impact on investment efficiency; 2) dual role has a moderating effect between financing constraints and investment efficiency; and 3) the proportion of independent directors has a moderating effect between financing constraints and investment efficiency. Therefore, we summarize the three hypotheses as the association between financing constraints, check-and-balance mechanism and investment efficiency as Figure 1.

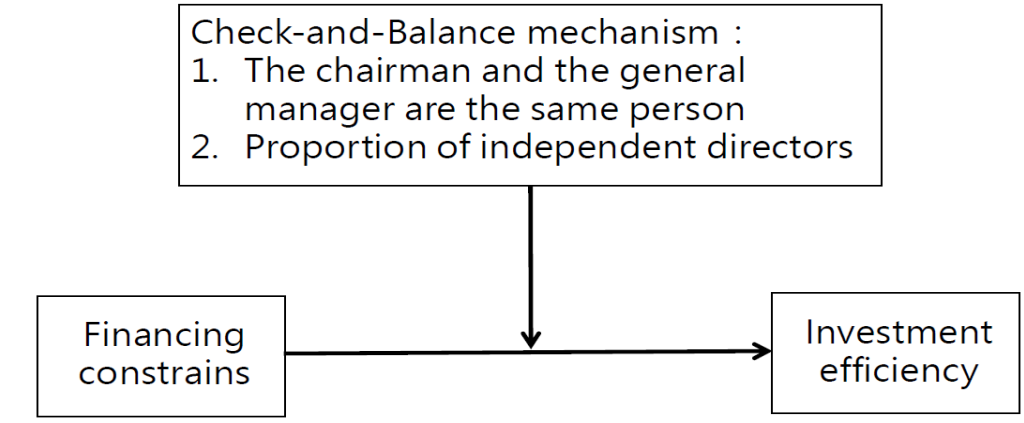

Figure 1 Diagram of the relationship between check-and-balance, financing constraints and investment efficiency

In recent years, China has been advocating digital industries, and the software and IT services industry is an important foundation for the development of digital industries. The increasing digitization of society has led to a very rapid

development of software and IT service industry with a wide range of customer base across various industries; however, it also implies that the operation of software and IT service industry requires more diverse talents rather than some specific high-level managers to dominate various decisions. Therefore, this paper examines whether check-and-balance moderate the relationship between financing constraints and investment efficiency in a sample of Chinese listed software and IT services firms. Figure 1 shows the relationship between checks and balances, financing constraints and investment efficiency, on which the research design will be based.

The research sample of this paper is the software and information technology service industry in A-shares of Chinese listed companies from 2017 to 2021. The data source of the sample is the CSMAR database, and the data are downloaded and firstly, incomplete information, special treatment shares, companies listed in the current year and those belonging to the Beijing Stock Exchange are deleted, and then extreme values are removed, resulting in a total of 843 samples. And considering the different scale and conditions of operation of the sample companies, a more in-depth discussion will be conducted to improve the practical reference value of the research results in this paper. In addition to the OLS method, the quantile regression method is also implemented in five levels of 5%, 25%, 50%, 75%, and 95% according to the degree of the explanatory variables, and then the empirical results of the two methods are compared. The following regression models are presented.

$$\mathrm{ININV}_{it} = \alpha_0 + \alpha_1 FC_{it} + \alpha_2 CHGM_{it} + \alpha_3 FC * CHGM_{it} + \alpha_4 AGE_{it} + \alpha_5 SCALE_{it} + \alpha_6 DEBT_{it} + \alpha_7 SOE_{it} + \alpha_8 FCF_{it} + \alpha_9 CYEAR_{it} + \varepsilon_{it} \quad (1)$$

$$\mathrm{ININV}_{it} = \alpha_0 + \alpha_1 FC_{it} + \alpha_2 INDEP_{it} + \alpha_3 FC * INDEP_{it} + \alpha_4 AGE_{it} + \alpha_5 SCALE_{it} + \alpha_6 DEBT_{it} + \alpha_7 SOE_{it} + \alpha_8 FCF_{it} + \alpha_9 CYEAR_{it} + \varepsilon_{it} \quad (2)$$

The definition of each variable in the regression model is described as follows.

2.1 Explanatory variable: The explanatory variable in this paper is inefficient investment (ININV), which is calculated based on Richardson's (2006) inefficient investment model to reflect the degree of inefficient investment of the company, and the larger the value indicates the worse investment efficiency.

2.2 Explanatory variables: the explanatory variable of this paper is financing constraint (FC), and the model to measure the degree of corporate financing constraint is established by the CSMAR database with reference to Hadlock and Pierce (2009), Zhou et al. (2010), Zhang et al. (2017), Gu et al. (2020), and Chen et al. It is used to reflect the degree of corporate capital easing, and the larger the number indicates the tighter the company's capital.

2.3 Moderating variables.

2.3.1 Two positions in one (CHGM): This variable is set as a dummy variable, set to 1 if the chairman and general manager are the same person, and set to 0 if they are different. In addition, considering the integrity of the check-and-balance mechanism, this variable is included as one of the control variables in model (2).

2.3.2 Independent directors' share (INDEP): The ratio of the number of independent directors to the total number of board of directors, calculated as: number of independent directors/total number of board of directors. This variable is set as a dummy variable, set to 1 if the chairman and the general manager are the same person, and set to 0 if they are different. In addition, considering the integrity of the check-and-balance mechanism, this variable is included as one of the control variables in model (1).

2.4 Interaction variables

2.4.1 Financing constraint and two-position unity (FC*CHGM): This variable is the interaction variable of financing constraint and two-position unity to examine whether the check-and-balance mechanism of two-position unity can play a moderating role.

2.4.2 Financing constraint and independent director ratio (FC*INDEP): This variable is an interaction variable of financing constraint and independent director ratio to test whether the check-and-balance mechanism of independent directors can play a moderating role.

2.5 Control variables

2.5.1 Firm age (AGE): Referring to Yan and Kong (2022) the firm age is used as one of the control variables, with the value of the number of years the firm has been

listed, and the data is taken from the CSMAR database.

2.5.2 Company size (SCALE): Referring to Yan and Kong (2022), the company size is used as one of the control variables, and the total assets of the company listed is used as the value, and the data is taken from the CSMAR database.

2.5.3 Debt ratio (DEBT): Referring to Wang et al. (2022), the debt ratio is used as one of the control variables, and the formula is: total liabilities of listed companies at the end of the period divided by total assets at the end of the period. The data in this paper are taken from the CSMAR database.

2.5.4 Nature of property rights (SOE): Referring to Wang et al. (2022), the nature of property rights is used as one of the control variables, and the enterprises in the sample are divided into state-owned enterprises and non-state-owned enterprises. If it is a state-owned enterprise take 1, otherwise take 0.

2.5.5 Free cash flow (FCF): Referring to Yan and Wang (2021), free cash flow is used as one of the control variables and the formula is: (net operating profit after tax + depreciation and amortization) - (capital expenditure + working capital increase). The data in this paper are taken from the CSMAR database. Data units are in millions of yuan.

2.5.6 New crown epidemic impact year (CYEAR): Based on the fact that the year 2020 is most severely affected by the new crown epidemic and the overall economy of the society suffers from a larger impact, this paper sets the year 2020 as one of the control variables, which is a dummy variable set to 1 if the sample year is 2020 and 0 otherwise.

4 Results

Before conducting empirical analysis, we must first have a general understanding of the overall sample. Table 1 is the descriptive statistics. This paper also explains the distribution of the overall sample.

Table 1 the description of each variable (N=843)

	Min.	Max.	Ave.	Stdv.
ININV	0.001	0.224	0.030	0.037
FC	0.055	0.945	0.610	0.229
CHGM	0.000	1.000	0.383	0.486
INDEP	0.333	0.500	0.383	0.050
FC*CHGM	-0.296	0.205	0.004	0.109
FC*INDEP	-0.035	0.030	0.001	0.011
AGE	2.000	27.000	8.584	5.889
SCALE	19.833	23.936	21.782	0.899
DEBT	0.047	0.797	0.358	0.173
SOE	0.000	1.000	0.151	0.358
FCF	-2359.999	1875.389	-33.850	528.973
CYEAR	0.000	1.000	0.223	0.417

Note：the definition of each variable refers to 3 Methodology.

The Descriptive statistics in table 1 shows that there is a wide range of investment efficiency in the overall sample of companies, but on average, the majority of companies do not have poor investment efficiency; the distribution of data on financing constraints and the average situation show that most of the sample companies do not have idle funds; in terms of check-and-balances, the overall situation shows that there are more companies where the chairman and the general manager are not the same person； and on average, the proportion of independent directors is slightly higher than the requirement of at least 1/3 of the seats. The overall distribution of the remaining control variables shows that the operating conditions of the sample companies are very different, so the use of quantile regressions in this paper should enhance the value of the study results in practice.

Tables 2 and 3 review the rationality of the regression model design, i.e., the important fit indicators of the linear regression equation before conducting the empirical analysis.

Table 2 the empirical result of model (1)(N=843)

Variable	Coefficient	t	p	VIF
Con_	0.088	1.155	0.248	
FC	-0.011	-0.838	0.402	5.529
CHGM	0.000	0.144	0.886	1.061
FC*CHGM	0.039	3.410	0.001***	1.030
AGE	-0.001	-4.838	0.000***	1.402
SCALE	-0.002	-0.531	0.596	5.327
DEBT	-0.008	-1.079	0.281	1.093
SOE	-0.007	-1.953	0.051*	1.171
FCF	0.000	0.033	0.974	1.008
CYEAR	-0.002	-0.685	0.494	1.025
F value	5.851***	Durbin-Watson	1.565	

Note 1：the definition of each variable refers to 3 Methodology.

Note 2：when p<=0.01 means the signification is " *** "， when 0.01<p<=0.05 means the signification is " ** "， when 0.05<p<=0.1，means the signification is " * ".

Table 3 the empirical result of model (2) (N=843)

Variable	Coefficient	t	p	VIF
Con_	0.068	0.873	0.383	
FC	-0.007	-0.546	0.585	5.504
INDEP	-0.014	-0.545	0.586	1.028
FC*INDEP	0.166	1.502	0.133	1.011
AGE	-0.001	-4.488	0.000***	1.380

SCALE	-0.001	-0.199	0.842	5.320
DEBT	-0.009	-1.155	0.248	1.089
SOE	-0.007	-1.795	0.073*	1.168
FCF	0.000	-0.048	0.962	1.010
CYEAR	-0.002	-0.661	0.509	1.026
F value	4.785***	Durbin-Watson	1.547	

Note 1：the definition of each variable refers to 3 Methodology.

Note 2：when p<=0.01 means the signification is " *** "， when 0.01<p<=0.05 means the signification is " ** "， when 0.05<p<=0.1，means the signification is " * ".

In the beginning, we have to confirm whether the regression design is reasonable by the OLS results in Table 2 and Table 3. The first step is to inspect whether there is excessive homogeneity among the variables. The indicator of homogeneity is the VIF values in Tables 2 and 3. According to the requirements in general literature, a VIF value of more than 10 indicates that there is significant homogeneity between two or more variables, while the highest value of VIF in Tables 2 and 3 is 5.529. Therefore, it can be determined that the research model in this paper does not have homogeneity in the selection of variables Next, we exam the F-value, the F-value is used to test whether the covariance of two or more sample means in the linear regression is significant, and if there is a significant difference, it means that the linear regression equation has predictive power. Finally, to check whether the residuals of the regression model are self-correlated, the representative index is the Durbin-Watson value, and the closer the value is to 2, the less self-correlated the residuals are, and the Durbin-Watson values of Table 2 and Table 3 are both around 1.5, which means that the residuals in the regression equation are not obviously self-correlated. The regression design of this paper is reasonable.

After reviewing the rationality of the regression models design, we proceed to the empirical analysis. Tables 4 and 5 show the results of the empirical analysis of the regression model (1) and model (2) by OLS and quantile regression, respectively. The tables are presented in the form of a comparison of the empirical results of the two

research methods in order to give the reader a clearer picture of the overall sample and the individual status of each stratum after the overall sample is divided into multiple strata, which can make the results of this paper more practically informative.

Table 4 the empirical result of quantile regression for model (1) (N=843)

Variable	5%	25%	50%	75%	95%	OLS
Con_	0.028**	0.058*	0.021	0.206*	0.290	0.088
FC	-0.003	-0.004	0.000	-0.033*	-0.027	-0.011
CHGM	0.000	0.000	-0.002	-0.003	0.012	0.000
FC*CHGM	0.004*	0.008	0.009	0.028*	0.156**	0.039***
AGE	0.000**	0.000***	-0.001***	-0.001***	-0.003**	-0.001***
SCALE	-0.001**	-0.002	0.000	-0.006	-0.007	-0.002
DEBT	-0.003**	-0.008**	-0.008	-0.009	-0.005	-0.008
SOE	0.001	0.000	-0.001	-0.008	-0.024	-0.007*
FCF	0.000**	0.000**	0.000	0.000	0.000	0.000
CYEAR	-0.001*	-0.004*	-0.002	0.001	-0.007	-0.002

Note 1：the definition of each variable refers to 3 Methodology.

Note 2：when p<=0.01 means the signification is “ *** ”， when 0.01<p<=0.05 means the signification is “ ** ”， when 0.05<p<=0.1，means the signification is “ * ”.

Note 3：the number in column is coefficient.

Table 4 examines the relationship between checks and balances, financing constraints and investment efficiency of the two positions of chairman and general manager, and analyzes whether the two positions can play a role in the check-and-balances between financing constraints and investment efficiency. First of all, the financing constraint and the two-positioning have no significant affect on the investment efficiency of the company, but the higher the financing constraint and the two-positioning, the lower the investment efficiency. The results of the quantile regression reveal that the higher the degree of financing constraint, the better the investment efficiency for companies with higher levels of inefficient investment; and for companies with excellent, not so good and very poor investment efficiency, the mutual check-and-balance between the authority of the chairman and the general manager can make better use of capital, which is in line with the research proposition

of Zhu and Ding (2016). The rest of the companies with intermediate investment efficiency, in terms of the significance of the control variables, may not be effective due to the lack of immediate risk awareness, so the check-and-balance do not work.

Table 5 the empirical result of quantile regression for model (2) (N=843)

Variable	5%	25%	50%	75%	95%	OLS
Con_	0.028***	0.053	0.008	0.180 *	0.387	0.068
FC	-0.002	-0.004	0.001	-0.029*	-0.062	-0.007
INDEP	0.002	0.013	-0.008	-0.020	0.054	-0.014
FC*INDEP	-0.013	-0.022	-0.045	0.198	0.408	0.166
AGE	0.000**	0.000**	-0.001***	-0.001***	-0.003*	-0.001***
SCALE	-0.001**	-0.002	0.001	-0.005	-0.011	-0.001
DEBT	-0.003***	-0.008***	-0.012**	-0.015	-0.032	-0.009
SOE	0.001**	0.001	0.000	-0.006	-0.027	-0.007*
FCF	0.000**	0.000*	0.000*	0.000	0.000	0.000
CYEAR	-0.001	-0.004***	-0.003	-0.003	0.009	-0.002

Note 1：the definition of each variable refers to 3 Methodology.

Note 2：when p<=0.01 means the signification is “ *** ”， when 0.01<p<=0.05 means the signification is “ ** ”， when 0.05<p<=0.1，means the signification is “ * ”.

Note 3：the number in column is coefficient.

Table 5 examines the relationship between independent directors' check-and-balance on the board of directors, financing constraints and investment efficiency, and analyzes whether the proportion of independent directors on the board of directors plays a role in the check-and-balance between financing constraints and investment efficiency. The empirical results of quantile regression analysis show that the higher the degree of financing constraints, the better the investment efficiency for firms with poor investment efficiency, which means that independent directors do not play a check-and-balance role in the investment efficiency and financing constraints. This is in line with the findings of Li and Jiang (2008) who found that the proportion of independent directors in China is small and lack of independence to influence the investment decisions of listed companies.

In the empirical results in Table 4 and Table 5, what is more different from the previous literature is that in the previous literature, it is mostly advocated that the higher the degree of financing constraints, the better the investment efficiency will be (Huang and Liu, 2022), but it is less obvious in the software and information

technology service industry, which should be related to the industry characteristics of the software and information technology service industry, which is a capital-intensive industry with investment The amount of money is usually relatively large, and it is not easy to make efficient use of funds if the degree of constraint is high.

5 Conclusion and recommend

This paper explores the relationship between the power check-and-balance mechanism between the degree of financing constraints and investment efficiency using OLS and quantile regressions for the software and IT service industry of A shares listed in China from 2017 to 2021, and we summarized the research findings as follow.

1. for the software and IT service industry, the higher the degree of financing constraints, the worse the investment efficiency.

2. Overall, the higher the degree of financing constraint, the more companies with a separation of power between the chairman and the general manager will be able to exercise check-and-balance, resulting in a significant increase in investment efficiency. This is especially significant in the two levels of very high and very low investment efficiency. The degree of independent directorship does not have a significant counterbalancing effect between financing and investment efficiency at any level of investment efficiency, and it is below the overall average, even in the opposite direction.

Software and IT service industry is an important force in the national digital development strategy, and has developed rapidly in recent years with good momentum and mature business model. With the characteristics of fast product renewal rate, fierce competition in the same industry and wide application fields, it is necessary to accelerate innovation, strengthen the integration of core elements such as technology, products, content and services, as well as to integrate more professionals in the field and accelerate the integration of innovation in various industry fields if we want to maintain our competitive advantage continuously. Therefore, all directors, supervisors and executives in the company must have a good concept of corporate governance. From the empirical results of this paper, it is found that Chinese current software and IT service industry is not yet perfect in the mechanism of check-and-balance of power in the company's operation, and the proportion of

independent directors is on average only slightly higher than the minimum requirement of the decree.

In response to the empirical results, this paper puts forward the corresponding recommendations as follows.

1. for the company: the software and IT service industry requires more extensive professional information, so any major decision on business investment must go through a professional and rigorous evaluation process. Therefore, the chairman and the general manager should be separated from each other, and the company should avoid implementing a system of two positions in one, and the chairman and the general manager should be served by different people. If the two posts are united, there will be no checks and balances on the power, and the supervisory function of the board of directors will be greatly weakened, which will easily lead to errors in judgment in major decisions. At present, the proportion of companies with two positions in Chinese software and IT service industry is only about 38%. Although the combination of two positions does not violate the law, it should be avoided as much as possible. In addition, although the independent directors of listed companies are elected by the shareholders' meeting, the major shareholders still hold the decisive voting power, so most of the independent directors are not independent, but only exist formally to cope with the regulatory authorities. It is also recommended that companies should establish a sound risk response mechanism, especially for companies with high financing constraints, so that they can improve their credit level and ability to resist risks and help their long-term development.

2. for regulators: Since most of the cases of listed companies with business failures or fraudulent financial reports in recent years are companies with two positions in one, it can be seen that there are indeed drawbacks. The findings of this paper also show the importance of the separation of power between the chairman and the general manager; and that the current performance of independent directors in the company falls short of the function that corporate governance is expected to perform. Therefore, it is recommended that individual provisions can be established for companies under specific operating conditions to strengthen the function of monitoring and check-and-balance mechanisms in corporate governance; and that pre-employment training for independent directors of companies be strengthened so that they understand the responsibilities they have and the rights they need to exercise

in the company to promote the company's position in the market.

3. for the government: at present, most of the enterprises in China are in the general background of economic transformation and epidemic prevention and control at the same time, enterprises must consider the unknown nature of the multifaceted environment when making investment decisions, and with the measures continuously taken by the state, investors are highly likely to multiply their confidence in the future economy and find better development opportunities at risk, therefore, the government should establish a relaxed investment and financing environment and optimize the economic system comprehensively to improve the efficiency of business investment.

6 Research limitations

This study takes the software and IT service industry of listed companies in China as the research sample. However, some large companies in this industry in China are listed abroad, so the samples in this paper may not represent the complete situation of this industry in China.

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