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The impact of highly concentrated shareholding on the effectiveness of internal controls and financial fraud risks in high-growth startups

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Abstract. High equity concentration is common in high-growth start-ups, but its impact on corporate governance and financial risks has not been fully studied - this is a key research gap in the existing literature. Equity concentration will lead to the failure of internal control and aggravate the risk of financial fraud through factors such as centralization of control, information asymmetry and weakening of governance mechanisms. The critical threshold of shareholders' rights or voting rights will lead to governance imbalance and weakening supervision, thus facilitating fraudulent activities. The main contribution of this paper includes the construction of a dynamic threshold model, which explains this nonlinear transformation: moderate concentration can improve efficiency through entrusted responsibility, while excessive concentration will trigger systemic fraud risks, because the solidification effect dominates. The main contributions also include proposing and supporting this nonlinear relationship in a consistent way, building a new start-up enterprise governance research and analysis framework that integrates agency theory and stewardship theory, and systematically analyzing the potential threats of equity concentration to emerging enterprises. This is to optimize the equity structure and improve the regulatory policy system, and provide theoretical basis and practical advice for high-growth start-ups.

Keywords: equity concentration, financial fraud, internal control failure, high-growth start-ups

1. Introduction

Although the equity concentration of high-growth start-ups may improve decision-making efficiency and market penetration in the early stage, the governance risks and financial fraud loopholes introduced by them in the process of enterprise growth have not received sufficient attention [1]. This study makes three main contributions: First, through the comprehensive application of agency theory, stewardship theory and institutional theory, the nonlinear relationship between equity concentration and internal control failure is proposed and mechanically proved, which proves the universal applicability of this relationship in high-growth start-ups. Secondly, through cross-border case comparison, it analyzes how high equity concentration affects corporate governance and financial fraud risks in the Chinese and American markets, and emphasizes how the differences in regulation and information disclosure aggravate the risk of fraud. Finally, practical

suggestions are put forward for the equity structure design of high-growth start-ups, emphasizing the importance of implementing checks and balances of power under the condition of high equity concentration to strengthen internal control.

Traditional corporate governance research mainly focuses on mature enterprises, paying special attention to the balance between decision-making efficiency and internal control under the background of equity diversification [2]. In contrast, high-growth start-ups usually rely on centralized control under the leadership of the founder or core team to speed up the decision-making process. However, when the scale of the enterprise reaches a certain level and the equity is excessively concentrated, this governance model may have an adverse impact. Through the case studies of Luckin Coffee, Qutoutiao and Kangmei Pharmaceutical, this article shows that when the equity or voting rights of the controlling shareholder exceed a specific threshold, the imbalance in the corporate governance structure will be aggravated, the internal control mechanism will be weakened, and the risk of financial fraud will also increase.

In order to ensure the authenticity, transparency and reproducibility of the research, all data and evidence used in this study come from the following channels: (1) Regulatory documents: Administrative Penalty Decision of the China Securities Regulatory Commission, Law Enforcement Action and Litigation Announcement of the U.S. Securities and Exchange Commission; (2) Company Disclosure: Luckin Coffee, Kangmei Pharmaceutical. Annual reports, prospectuses and internal control evaluation reports of Co., Ltd., Uber, WeWork, Theranos, Ofo and Qutoutiao; (3) Academic database: SSRN's journal articles and working papers (consistent with the cited research); (4) Investigative news reports: Financial News, Financial Times, Wall Street Journal and other media reports; (5) Industry standards: EU Bureau of Statistics-ESCO Business Demographic Manual; (6) Quantitative data: financial indicators and market data from Compustat, Bloomberg and CapitalIQ databases.

2. Definition and core characteristics of high concentration of shareholders

2.1. Definition and criteria

The high concentration of shareholders means that specific shareholders hold absolute or relative majority voting rights through various mechanisms, thus substantially controlling the governance of the company's major decisions [3]. The key lies in its actual control ability, not just the shareholding ratio.

This study focuses on high-growth start-ups, and its definition refers to the Eurostat-OECD Manual on Business Demography Statistics. Start-ups refer to enterprises that meet the criteria of "enterprise birth" (formed by a new combination of production factors, not merger or reorganization, and established for no more than five years). High-growth enterprises refer to enterprises with an average annual growth rate of more than 20% in three years (verified by employment or income data), while start-ups that have been established for no more than five years are classified as "gazelle enterprises", which is the core sample of this study.

Equity concentration needs to distinguish between cash flow rights (proportion of economic benefits) and control (decision-making leadership), and the degree of separation between the two is crucial to determining the substantive impact [4]. The evaluation criteria should be verified through multi-dimensional coordination. The first is the equity concentration index (HHI): for mature enterprises, the HHI value exceeds 2,500, which means that the equity concentration is high; for start-ups, the threshold will be dynamically adjusted (A/B round financing: 3,000; C round financing: 2,500) [5]. In addition, the voting threshold requires that the actual voting rights exceed 70% to constitute absolute control, and the condition of "voting rights/cash flow rights deviation > 2" is added [4]. Finally, the control mechanism involves special equity arrangements (e.g., AB shares, concerted action agreements), in which a single entity's control of more than 50% of voting rights

directly determines the high concentration of equity [3]. These indicators are used in combination to avoid the deviation of a single indicator.

Excessive concentration of equity will weaken the supervision mechanism, hinder the flow of information, and increase the risk of internal control failure [6]. In the face of financing pressure and valuation requirements, early venture capital/private equity investors often ignore internal control. As the company advances to the C/D round of financing or IPO preparation, the controlling shareholder may resort to financial beautification to evade regulatory review, which may lead to accounting fraud [7].

2.2. Phased evolution of characteristics

In the seed round stage, the founding team holds more than 50% of the shares ("founder-led" structure). This structure is conducive to quick decision-making, but lacks external supervision, thus introducing the governance risk of abuse of control [8]. From the perspective of the stewardship theory, when the governance structure aligns personal goals with organizational goals, managers (or controlling shareholders) should play the role of trustees of the company's interests [1]. Therefore, the founder initially plays the role of trustee of the company's value. However, with the expansion of the company, the lack of checks and balances may lead to deviations from the interests of the organization [1].

When the company enters the growth stage, the introduction of external capital diversifies the equity structure. Nevertheless, the founder may still retain substantial control through high-voting shares or voting entrustment agreements [8]. This separation of control and cash flow has exacerbated the conflict of interest between controlling shareholders and external investors. In addition, there is a lack of governance constraints to prevent resource allocation from favoring private interests [4]. The entrenchment effect of major shareholders has become prominent, while the alignment effect of equity ownership has gradually weakened [4].

3. Typical forms and case studies of equity concentration

3.1. Direct shareholding dominance model

This model refers to the fact that the founder or the core management gains substantial control by directly holding more than 30% of the equity. It is characterized by a clear governance path and high decision-making efficiency (for example, Dai Wei, the founder of Ofo, holds 40% of the shares before the A/B round of financing).

However, the lack of checks and balances hinders effective supervision. Agency theory believes that the separation of ownership and control is the root cause of conflict in the entrusted agent [2]. The controlling shareholders pursue private benefits of control through resource misappropriation and evasion of supervision.

For example, the founder of Theranos (directly holds more than 50% of the shares and rejects external technical verification) and Ma Xingtian of Kangmei Pharmaceutical (which undermines the independence of corporate governance by controlling the board of directors through direct shareholding).

This model systematically weakens internal control by disrupting the checks and balances mechanism, simplifying the decision-making process and controlling information disclosure. The founding team of Luckin Coffee had the sole decision-making power before the IPO, which led to large-scale financial fraud due to weak supervision [9].

3.2. Nested partnership structure model

Its core principle is "Leverage control with minority equity": the founder or core shareholder arranges centralized voting and decision-making rights through contracts, while other investors only enjoy economic benefits [3].

This model balances control and financing flexibility, but widens the gap between control and cash flow [4]. For example, the founder of Uber (as a general partner, the shareholding ratio is less than 10%, but dominates the core decision-making) and Ma Xingtian (the shareholding ratio is less than 20%, but indirectly controls 30% of the voting rights) [4].

This deviation exacerbates the agency problem and the devaluation of the company's value [10], undermining the information transparency and power balance mechanism [11]. It is difficult for other investors of Kangmei Pharmaceutical to supervise the capital operation [4]. The founder of WeWork holds 65% of the voting rights through this structure and dual equity structure, which lacks effective supervision, resulting in high valuation of related transactions and inflated valuations, and ultimately causing a collapse in valuation.

Enterprises that adopt this model should clarify the approval procedures for related parties' transactions, require full disclosure of information, obtain the consent of the majority of investors, and achieve risk isolation through reasonable mechanisms.

3.3. Dual equity structure model

The dual equity structure (AB share system) maintains control in the case of equity dilution through "voting rights amplification" to meet the financing needs of start-ups and enhance the bargaining power of founders [12]. Luckin Coffee's founding team retained 75% of the voting rights in rounds A and B financing, ensuring the continuous implementation of the early strategy.

However, this model has the risk of impairing the independence of the board of directors, hollowing out the governance structure and exacerbating the bias of information disclosure. Information disclosure bias refers to the selective, delayed or ambiguous disclosure of company information, covering up internal control defects and weakening the effectiveness of external supervision [6]. The founder of Qutoutiao exercised disproportionate voting rights through AB shares, suppressing the opinions of independent directors. Luckin Coffee's internal audit failed to verify the authenticity of the order, and insufficient risk disclosure led to a sharp drop in market value after the fraud scandal was exposed [9]. Therefore, the application of this system requires sound internal control and external supervision mechanisms to avoid governance failure and financial fraud caused by excessive concentration of control [6, 13].

4. Impact mechanism of share concentration on internal control effectiveness

4.1. Supervisory failure from the perspective of agency theory

Excessive concentration of equity will aggravate information asymmetry and conflicts of interest of entrusted agents - controlling shareholders have decision-making power and information advantages, and often make decisions that harm the overall interests of the company [2]. Equity concentration will produce a "reward and punishment" mechanism: although increasing the cash flow rights of major shareholders can enhance their supervision and incentives, excessive control may lead to the exploitation of minority shareholders, thus exacerbating regulatory failures [5]. From the perspective of agency theory, this stems from the "economic man" hypothesis - managers use information advantages to pursue private benefits of control in the absence of effective supervision, and equity concentration will weaken core governance tools (such as board supervision,

equity checks and balances), thus exacerbating the agency problem [14]. There is a view that the separation of ownership and control is the root cause of agency costs, which is especially prominent in the structure of high equity concentration [2].

The real consequences of this failure are very serious. The founder of Uber only holds 10% of the equity (a difference of 40 percentage points), but retains 50% of the voting rights, which deprives minority shareholders of the right to supervise and leads to the failure of the internal control mechanism [8]. Similarly, in Kangmei Pharmaceutical, the Ma Xingtian family controls more than 80% of the board seats, forming a "dominant internal control" pattern - even if a minority of shareholders find risks, it is difficult to promote corrective measures; and the dependence of controlling shareholders on their own resources reduces the importance to the formal governance mechanism and further weakens The effectiveness of internal control [4]. Research shows that fraudulent companies usually manipulate financial leverage by inflating assets and falsely reporting liabilities [7], and excessive institutional shareholding tends to cover up internal control defects [6].

Together, these cases show that the impact of equity concentration on corporate governance is not monotonous, but follows a unique nonlinear trajectory that depends on thresholds. This study formally describes this dynamic through the dual mechanism framework. In the "due diligence management area", the consistency of the founder's interests and long-term organizational values promotes efficient decision-making and proactive internal control environment, because the controlling shareholder plays the role of responsible trustee. However, when the concentration of equity exceeds a key theoretical inflection point (conceptually defined as the stage when absolute voting rights are decoupled from the corresponding economic risks, for example, the deviation between voting rights and cash flow exceeds 2), the logic of corporate governance will undergo a fundamental change. After this point, the "power solidification zone" becomes the dominant mechanism: the lack of an effective check and balance mechanism leads to the systematic "hollowing" of the supervision mechanism. Therefore, the collapse of the effectiveness of internal control is not gradual, but accelerates with the concentration of power, because the concentration of power makes it possible to deliberately bypass audit and disclosure agreements, thus triggering a non-linear exponential increase in financial fraud risks [1].

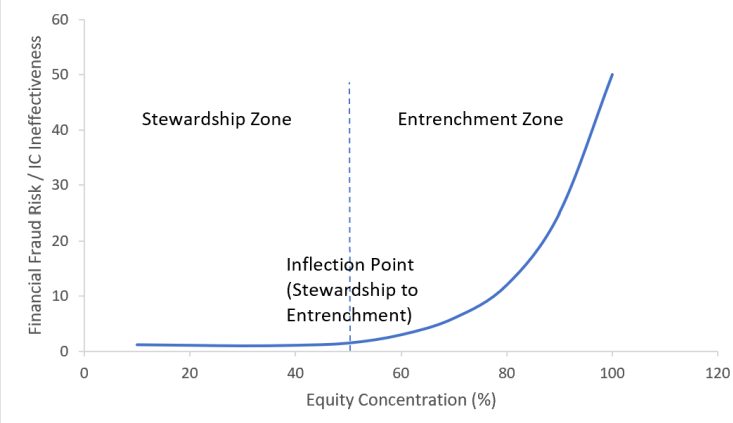

Figure 1. The nonlinear relationship between equity concentration and financial fraud risk

Figure 1 shows the visual representation of the nonlinear evolution curve. The relationship between equity concentration and fraud risk forks at the critical inflection point (about 50%-67% of voting rights). In the "stewardship zone" with moderate equity concentration, the consistency of the founder's interests with the company's goals will produce a "trusted management effect", thus maintaining high internal control efficiency and suppressing the risk of fraud. On the contrary, once the equity concentration exceeds this threshold, the

"solidification effect" will become the dominant force in the "solidification zone". The concentration of absolute control will lead to the systematic "hollowing" of the internal supervision mechanism, thus triggering an exponential increase in the risk of financial fraud - the extreme M-Score and F-Score anomalies observed in cases such as Luckin Coffee confirm this phenomenon. This shift shows that excessive concentration will weaken the effectiveness of the checks and balances mechanism, resulting in structural loopholes and putting enterprises at risk of systemic fraud.

4.2. Governance imbalance in stewardship theory

In an organizational structure with a high concentration of equity, the lack of effective checks and balances tends to distort the core principles of the stewardship theory. When the controlling shareholder puts personal goals above the organizational goals, the inherent consistency necessary for effective trust responsibility will be destroyed, leading to serious governance imbalance [1]. This misalignment weakens the trust responsibilities of the controlling shareholders and structurally destroys the entire corporate governance framework.

The actual manifestation of this imbalance is reflected in some high-profile cases of governance failure. For example, in Kangmei Pharmaceutical, the monopoly of the Ma Xingtian family over resource channels makes the board of directors structurally dependent on the family, which actually loses the independence of the board of directors [4]. Similarly, the excessive concentration of voting rights in companies such as Luckin Coffee (75% of the voting rights) and WeWork make it impossible for external investors to conduct effective supervision, thus creating an environment where decision-making is easily affected by bias [11].

These cases highlight a fundamental contradiction: although the trust management theory believes that the efficiency of corporate governance depends on the founder as a responsible trustee, this role can only be maintained through appropriate checks and balances mechanisms [1]. Without these constraints, centralized control will inevitably evolve into "governance capture" - the absolute power of the founder is superior to internal control - thus creating major structural loopholes and providing opportunities for financial fraud.

4.3. Information disclosure bias

Information disclosure bias is an external manifestation of the failure of internal control in information transmission, and the high concentration of equity will aggravate this problem [6]. Management controlled by controlling shareholders will conceal information about internal control defects to avoid market questioning and reduce external regulatory constraints [6] - which is consistent with the selective/vague information disclosure practices of Luckin Coffee and Qutoutiao. This deviation will lead to investor misjudgment, increased information asymmetry, resource mismatch and loss of market trust, which will have a negative impact on the financing capacity and valuation of enterprises [7]. Ashbaugh-Skaife et al. found that internal control defects affect the quality of information disclosure, and information disclosure deviations will further amplify these negative effects [6].

4.4. Regulatory gaps in the institutional framework

Regulatory loopholes reflect the systemic defects of the institutional environment related to information disclosure, board independence and related party transaction control [11] - while the highly concentrated equity structure forms a symbiotic relationship [11]. The current regulatory system has such systemic defects, and start-ups lack a mature governance structure - unclear regulatory boundaries, insufficient disclosure of equity/related transactions, and the board of directors controlled by the founder. Weak related party transaction control mechanisms often lead to internal control failure and financial fraud [7].

Regulatory blind spots and weak law enforcement lead to selective compliance or circumvention - lag intervention in high-growth start-ups, inconsistency in venture capital/private equity governance standards, and insufficient cross-border audit coordination enable equity-concentrated enterprises to manipulate financial performance through off-table activities [7]. There is a view that the law and economics of self-transaction are closely related to the institutional environment, and regulatory loopholes provide institutional space for major shareholder fraud [11] - for example, Kangmei Pharmaceutical covers up internal control defects by increasing assets and concealing related transactions, and regulators fail to intervene in time [4]. Strengthening supervision and law enforcement and improving institutional adaptability are crucial to improving the quality of start-up governance [11].

5. Comparative analysis of Chinese and American case studies

5.1. Governance failure pathways of Luckin Coffee and WeWork

Both Luckin Coffee and WeWork have adopted a highly centralized governance framework, which eventually led to the failure of governance. Before the outbreak of Luckin Coffee's fraud scandal in 2020, its equity was firmly controlled by the Lu Zhengyao family through multi-layer equity design and differentiated voting mechanism; in the same way, Adam Neumann, the founder of WeWork, also obtained "super voting rights" through the dual equity structure in the IPO preparation stage in 2019. Both companies fundamentally lack an effective equity check and balance mechanism [8].

These governance defects are characterized by the fact that the board of directors is generally controlled by a few people and the supervision mechanism is weak [12]. At Luckin Coffee, the board of directors failed to fulfill its responsibilities. The independent directors did not question the management's radical strategy and did not verify the authenticity of financial data, resulting in systematic internal control defects. Similarly, the board of directors of WeWork lacks real independence; Neumann's unilateral control of the appointment of directors has weakened governance autonomy and hindered any critical investigation into high-risk expansion plans [14]. Emirical studies on companies with dual equity structure consistently show that the lack of board independence is a major governance loophole in centrally controlled enterprises [8].

The resulting failure of internal control directly reflects the misconduct of management fueled by structural imbalance. Luckin Coffee fabricated revenue by manipulating order coding rules to increase sales, while Neumann, the founder of WeWork, made the company unable to make strategic adjustments in time. Both incidents highlight how the concentration of power distorted the organizational incentive mechanism. These companies have all encountered a systemic crisis of trust: Luckin Coffee is facing delisting after the exposure of fraud, while the failure of WeWork's IPO has triggered a catastrophic valuation collapse.

In a word, these cases vividly show proxy-based regulatory failures and information disclosure deviations. The absolute control of the founding team allows them to bypass internal audits and manipulate operational data, which shows how excessive concentration makes the supervision mechanism virtual. These cases verify the theory of "power solidification zone", that is, the decoupling of control from economic risks will cause the structural conditions of nonlinear growth of financial fraud risks.

5.2. Fraud mechanisms of Kangmei Pharmaceutical and theranos

The highly centralized equity structure has created institutional loopholes, which facilitated the manipulation of resources and information. Take Kangmei Pharmaceutical as an example. Between 2016 and 2018, the company took advantage of weak internal control to significantly increase its revenue and cash reserves.

Similarly, Elizabeth Holmes, the founder of Theranos, has received huge investments through strategic hype, while the lack of external oversight has been covering up systematic fraud for years [9].

These fraudulent methods reflect the shortcomings of structural governance: Kangmei Pharmaceutical forged bank statements and established illegal customer-supplier relationships to cover up financial loopholes [4], while Theranos manipulated blood samples and tampered with test result. Both cases expose the systemic internal control defects inherent in the highly centralized equity structure. This is consistent with the results of empirical research, which show that excessive concentration of control reduces the effectiveness of internal oversight and exponentially increases the possibility of fraud [4]. Crucially, as pointed out in recent literature, this profit manipulation manifests as abnormal fluctuations in key financial indicators, especially asset quality and gross margin, which are early warning signals for the collapse of internal control [9].

These consequences and the subsequent regulatory responses show that it is imperative to rebalance the corporate governance structure. Kangmei Pharmaceutical went through compulsory investigation, reorganization, and finally delisted. After the restructuring, the company introduced strategic investors to dilute the shareholding ratio of the Ma family to less than 5%, and significantly strengthened the independence of the board of directors by appointing 40% of external directors and establishing an audit committee composed entirely of independent directors. This shift to the model of "strategic investors + independent directors + supervisory board" proves that improving the autonomy of the board of directors and strengthening investor protection can effectively alleviate the negative externalities caused by high equity concentration [6].

In a word, these cases are typical examples of the imbalance of corporate governance caused by the distortion of trust liability. The holding party's monopoly on board seats and resource channels weakens the independence of the corporate governance structure, which provides an empirical basis for the "trusted responsibility effect" to be reduced to private interests once the equity concentration exceeds the theoretical inflection point. These examples confirm that we are transitioning to the "solidification zone", in which the loopholes in institutional supervision and the lack of external checks and balances have led to the systematic hollowing out of the internal supervision mechanism.

5.3. Differences in risk evolution between Ofo and Uber

The governance experience of Ofo and Uber provides an eye-catching comparative analysis of how different equity structures affect risk evolution. Ofo's equity structure is characterized by intense internal friction. Didi's shareholding gives it the right to veto, which effectively weakens the decision-making power of the founding team. In contrast, Uber's early equity concentration gave the founder long-term strategic autonomy, which promoted the company's rapid growth in the early days, but eventually exposed systematic internal control defects, leading to the founder's final resignation [4, 8].

These completely different governance models have led to a completely different risk evolution path, both of which are consistent with the nonlinear risk model proposed in this study [4]. The risk trajectory of Ofo follows the model of "capital chain breakage - market evacuation - user trust collapse", which is mainly driven by liquidity and capital constraints. On the contrary, Uber's development path is "governance failure - market trust collapse - strategic retreat". The different institutional environments of the two countries have further exacerbated these differences: China's sharing economy has undergone rapid regulatory changes - such as the introduction of deposit regulatory policies - while the U.S. regulatory framework relies more on litigation and market mechanisms to force Uber to make security and compliance adjustments [11]. As the study of anti-acquisition clauses shows that the structural governance mechanism significantly affects the innovation and strategic adaptability of enterprises [15], which explains why Uber can successfully implement strategic retreats and reduce risks, while Ofo eventually collapses.

The failure of Ofo's later attempt to integrate into the Alibaba ecosystem as a strategic investor was largely due to the control dispute that was difficult to solve. This highlights the urgency of high-growth start-ups to actively manage the balance between founder control and capital supervision through dynamic equity adjustment mechanisms [3].

The completely different development paths of Ofo and Uber jointly verify the nonlinear risk model proposed in this study. Uber's governance crisis triggered a strategic retreat and eventually compliance adjustment - thanks to the flexibility of its governance, it was able to recover - and Ofo failed to achieve an effective balance between founder control and capital supervision, which eventually led to its complete collapse. These cases show that the combination of institutional regulatory loopholes and rigid control structures will amplify risks, and dynamic equity rebalancing is a necessary mechanism to prevent enterprises from sliding from the "due diligence zone" to the final "solidification zone".

5.4. Differences in risk exposure between China and the West

Institutional, regulatory and cultural differences deeply affect the occurrence and suppression of financial fraud. Although China's collectivist culture has improved the efficiency of decision-making in the early stage, it is also prone to breed fraud due to the large distance between power and the lack of checks and balances [1].

The regulatory system of the United States emphasizes investor protection and transparency [5]; China shows institutional flexibility in terms of cross-border audit supervision and the depth of information disclosure. Differences in governance mechanisms determine the applicability of fraud risk identification models: strong information disclosure and joint regulatory mechanisms in the United States help to detect fraud early; China's fraud risks are concentrated and exposed. The adjustment of model parameters needs to reflect market differences - the current fraud prediction research is turning to machine learning, and the integration of traditional models and new technologies improves the prediction accuracy. There is a view that the ownership structure of global enterprises is affected by the institutional environment, and this difference will affect the risk exposure of equity-concentrated enterprises [5].

6. Manifestations and transmission pathways of internal control failure

6.1. Formalized governance structure

Formalized corporate governance structure refers to a mechanism that is reasonably structured but essentially invalid, which can only achieve superficial compliance [14]. Therefore, people's substantial attention to reasonable governance mechanisms has decreased [1]. The study found that the composition and independence of the board of directors are closely related to financial reporting fraud, which supports the view that the formalized corporate governance structure will increase the risk of fraud [14].

In start-ups with highly concentrated equity, its core characteristics include overlapping roles of the board of directors/controlling shareholders, lack of independence of independent directors and centralization of decision-making (Qutoutiao, Kangmei Pharmaceutical) [14] - related party transactions do not require independent review, frequent capital occupation and non-compliant guarantees. Formalized corporate governance will lead to weak supervision, lack of checks and balances, and failure of key control points - thus weakening the effectiveness of internal control (Luckin Coffee's radical expansion strategy [2]).

6.2. Hollowing of internal audit

The hollowing out of internal audit refers to the loss of independence of the internal audit department of the enterprise due to excessive concentration of equity, thus hindering the effective restraint on the behavior of the controlling shareholder and invalidating the internal audit [6]. The core problem is the loss of independence - the excessive concentration of equity erodes the independence of the internal audit department and hinders the effective restraint on the behavior of the controlling shareholder [6]. The internal audit of Qutoutiao failed to find the authenticity of the traffic; Luckin Coffee's internal audit failed to verify the authenticity of the order during the expansion period, resulting in a false increase in revenue [9]. Ashbaugh-Skaife et al. found that internal control defects affect enterprise risks, and the hollowing out of internal audits is an important manifestation of such defects [6].

Internal audit failure will trigger a chain reaction: financial control defects will damage the authenticity of financial statements; operational control defects will lead to resource mismatch; compliance control failure will expose the company to regulatory/legal risks (such as Uber data leakage). The hollowing out of internal audit is a typical manifestation of the failure of internal control under the condition of high equity concentration. The root cause is the loss of governance checks and balances [4].

6.3. Information disclosure bias

As described in Section 4.3, in an environment where equity is highly concentrated, the deviation of information disclosure manifests as selective disclosure, delayed disclosure or ambiguity in information disclosure, thus covering up internal control defects and weakening the effectiveness of external supervision. This deviation is not only a manifestation of internal control failure, but also its transmission channel, which further exacerbates information asymmetry and creates a prerequisite for financial fraud. The study found that the quality of information disclosure is closely related to financial reporting fraud, and the deviation of information disclosure provides an opportunity for fraud [7].

6.4. Transmission mechanisms of financial fraud

In an environment where equity is highly concentrated, systematic internal control defects (the failure of the supervision mechanism, the hollowing out of internal audits, and the deviation of information disclosure - see Section 4.1/4.3/6.2) will create institutional loopholes for financial fraud (Qutoutiao, Luckin Coffee Cases). Financial fraud stems from the interaction between motivation (performance pressure, capital expansion demand), opportunity (internal control loopholes, regulatory blind spots) and rationalization (management cognitive bias) - that is, the fraud triangle theory [9].

For high-growth start-ups, performance pressure and capital expansion demand constitute their motivation [8], while internal control loopholes under high equity concentration provide core opportunities [4], and management cognitive bias constitutes rationalization [1]. Financial fraud is mainly manifested in revenue manipulation and data falsification, which are directly related to internal control defects [7]. In companies with high equity concentration, control monopoly will cause "insider control", while special arrangements (double equity structure, agent shareholding) will strengthen the fraud transmission chain of "control → decision-making → execution", making fraud easier to implement and more difficult to detect [10, 12]. The M-Score model aims to detect surplus manipulation and has been widely used in financial fraud research [9].

7. Financial fraud risk identification and quantitative validation

It is crucial to clarify the methodological role of the Beneish M-Score, Altman Z-Score and F-Score models used in this study. These quantitative models are not used to establish a causal relationship between equity concentration and financial fraud, but as diagnostic verification tools to assess the severity of internal control defects and the prevalence of fraud signals in high-growth start-ups in the sample. Although these models can provide strong evidence of financial anomalies, such as income inflation or deterioration of asset quality, they themselves do not prove a causal relationship between ownership structure and financial anomalies. Therefore, this study adopts a comprehensive method to use these financial indicators to quantitatively verify the qualitative conclusions based on the theory of agency and the theory of entrusted responsibility. The triangular verification of this method ensures that the observed "nonlinear" risk escalation phenomenon can be verified by the corporate governance model and empirical financial anomalies at the same time, thus reducing the risk of empirical over-inference and enhancing the reliability of research results.

7.1. Application of the Beneish M-score model

Among the eight core variables of the Beneish M-scoring model, the Accounts Receivable Turnover Days Index (DSRI), Gross Margin Index (GMI), Asset Quality Index (AQI), Sales Growth Index (SGI) and Total Accrued Cost-to-Total Asset Ratio (TATA) are key forecast indicators [9]. Their identification logic and coefficient characteristics have obvious economic significance: the DSRI coefficient is 0.920 (t statistics is 6.02), which can most significantly identify income inflation; GMI (> 1.036) indicates a decline in gross margin; AQI (> 1.000) reflects a decline in asset quality; SGI (> 1.411) indicates rapid sales growth (high-growth companies have a risk of fraud); TATA (> 0.034) indicates that the accrued is too high [9].

The critical value of the model is -1.78, which has strong statistical validity - in the independent sample from 1989 to 1992, its identification rate of fraudulent enterprises reached 50% [9]. The robustness test confirms the stability of the core variable coefficient [9]. Its limitations include the limited ability to identify unregulated implicit fraud, and it is only applicable to profit overvaluation fraud of listed companies - which requires comprehensive judgment in combination with non-financial factors (industry characteristics, corporate governance structure) [9]. The empirical results in Table 1 provide quantitative evidence for this nonlinear risk surge. For example, Luckin Coffee's extreme M-Score value is as high as 2,994.18, indicating that once the equity concentration exceeds the security threshold, the effectiveness of internal control will not only decline, but also collapse completely. This is reflected in the exponential Deviation of Income Inflation (DSRI) and Asset Quality Index (AQI), confirming the non-linear growth of fraud risk in the consolidation stage [7].

Excessive concentration of equity will cause the risk of financial fraud in many ways [4]: controlling monopoly will weaken the independence of governance institutions (internal control); weak internal control will cause institutional loopholes; special arrangements will strengthen the chain of fraud.

Table 1. Beneish M-score model application results

Company	Year	M-Score	Critical abnormal indicator	Fraud risk determination
Luckin Coffee	2018	2,994.18	DSRI = 1.82 (revenue inflation), CFOI = 0.3 (low profit quality)	High risk
Kangmei Pharmaceutical	2018	1.5	AQI = 1.6 (asset inflation), DEPI = 1.8 (debt expansion)	High risk
WeWork	2020	-1.2	CFPI = 0.6 (cash flow manipulation), GMI = 1.3 (gross margin inflation)	Very high risk
Uber	2017	-1.92	No abnormal indicators detected.	Low risk

The differences in the institutional environment between China and the West affect the characteristics of risk exposure [11]: strict supervision in the United States can detect fraud early; China's institutional flexibility leads to the concentration of fraud risks.

7.2. Validation of the Altman Z-Score model

The Altman Z-Score model is a classic tool for assessing the financial health of a company, which is mainly used to predict the risk of bankruptcy. It evaluates five core financial indicators from the dimensions of liquidity, profitability, leverage structure and operational efficiency. The key threshold is set at 2.99 (safe zone), 1.81 (gray zone) and below 1.8 (crisis zone).

Too high equity concentration may distort the company's financial structure - fraudulent companies will increase profitability and manipulate leverage, thus creating a "false sense of security" in the Z-Score model [7]. Limitations of variable measurement: The effectiveness of a single financial model in predicting fraud is limited - it requires the integration of financial and non-financial factors [14]. The core equity concentration influence variable ("control-cash flow deviation" [4]) is not included in the quantitative model, resulting in insufficient accuracy in the evaluation. Theoretically, the deviation is the core cross variable of the agency theory and the stewardship theory [1, 2] - the greater the deviation, the stronger the motivation and ability of the controlling shareholder to obtain benefits. High equity concentration often gives controlling shareholders great power. Claessens et al. [4] pointed out that the separation of control and cash flow rights is the main driver of agency problems in such structures. In addition, Dechow et al. [7] also pointed out that financial statement fraud can distort key financial ratios, thus significantly reducing the prediction accuracy and validity of traditional models (such as Altman Z-Score).

7.3. F-Score evaluation system

The F-Score model uses nine indicators (0-9 points; less than 5 points indicates poor financial quality and potential fraud risks) to assess financial health through the three dimensions of profitability, asset efficiency and financial leverage. Start-ups should dynamically adjust the scoring threshold according to the development stage and equity structure [9]. Table 2 shows the application results of the F-Score model in typical cases.

Table 2. F-Score model application results

Company	Year	F-Score (Adjusted)	Key Defect
Luckin Coffee	2018	3 (low)	Operating cash flow < net profit (0 points), declining gross margin (0 points)
Kangmei Pharmaceutical	2018	1 (low)	Net profit inflation (0 points), asset-liability ratio increase (0 points)
Uber	2017	6 (high)	Positive operating cash flow (1 point) and stable asset turnover ratio (1 point)
Theranos	2016	3 (low)	Negative operating cash flow (0 points), insufficient R&D investment (0 points)

The model can effectively detect financial abnormalities by analyzing the logical correlation of indicators, which is very suitable for identifying fraudulent behavior of start-ups [7]. The low scores of Luckin Coffee, Kangmei Pharmaceutical and Theranos are consistent with the conclusion of fraud risk drawn by the Beneish M-Score model. The root cause is the failure of internal control caused by high equity concentration [6]. Dechow et al. found that the quality of information disclosure is closely related to financial reporting fraud, and the deviation in information disclosure provides an opportunity for fraud [7].

7.4. Differences in risk exposure between China and the West

As mentioned in Section 5.4, the institutional, regulatory and cultural differences between China and the West will affect the occurrence and suppression of financial fraud, which in turn affects the applicability of the fraud risk identification model. The adjustment of model parameters needs to reflect market differences, and the integration of traditional models and new technologies (machine learning) can improve the prediction accuracy [1]. Cross-border enterprises face the risk overlap of "internal control failure + regulatory differences" [11]. North believes that the system and its changes will affect economic performance, and this difference is reflected in the risk exposure of enterprises with high equity concentration in China and the West [16].

8. Multidimensional impacts of risk shocks

8.1. Resource allocation distortion and strategic deviation

Excessive concentration of equity will lead to a monopoly of control, so that the controlling shareholders dominate the allocation of resources and put short-term goals above long-term value optimization [4]. Luckin Coffee prioritizes store expansion over product quality/cost control; Qutoutiao focuses on user growth and ignores compliance and financial health. Corporate strategy deviates from core values - WeWork prioritizes rapid growth/valuation improvement; Kangmei Pharmaceutical overinvests in non-core business with insufficient R&D investment.

Theoretically, the stewardship theory (controlling shareholder resource monopoly [1]) and the proxy theory (centralized control to motivate personal interest-oriented resource allocation [2]) jointly distort resource allocation - Luckin Coffee's store expansion resource monopoly and abuse of control deviate from the value creation path. Claessens et al. found that the separation of ownership and control is the root cause of the

inefficient resource allocation, which is consistent with the strategic deviation of high-growth start-ups with equity concentration [4].

8.2. Declining operational efficiency and erosion of organizational trust

Failure of internal control and information distortion will lead to a decline in the efficiency of systematic operations - rigid decision-making, distorted information flow, and inefficient execution - and insufficient meetings of the audit committee and the low proportion of external directors will aggravate this situation [14]. Internal control defects can be divided into "organizational level" (the control environment is ineffective and the management is above internal control) and "account level" - the defects at the organizational level are caused by insufficient resources and weak governance (controlling shareholders reduce internal control investment).

The collapse of organizational trust stems from information distortion and poor management [14]: lack of internal audits weakens the ability to detect fraud early, and systemic defects (management over internal control) can systematically undermine trust. The exposure of Theranos' technology fraud led to the collapse of internal trust; Luckin Coffee's fraud scandal led to low employee morale - triggering a chain reaction of declining stakeholder confidence. Doyle and others study found that the determinants of internal control defects include the size and complexity of the company, which are particularly prominent in high-growth startups with concentrated equity [17].

8.3. Brand value erosion and market trust crisis

Financial fraud damages brand value through information distortion, performance misrepresents and misleading forecasts [9]: Luckin Coffee fabricates data to raise market expectations; Kangmei Pharmaceutical misstates profits/assets. The market trust crisis escalated from partial suspicion to a full-scale collapse [7]: Qutoutiao lost advertisers after data manipulation and exposure; WeWork's valuation plummeted due to operational data falsification. As a result, a vicious circle is formed: valuation devaluation → financing difficulties → strategic contraction → further loss of trust - brand value declines sharply [10]. Some people believe that investor protection is closely related to corporate valuation, and financial fraud will damage investor trust and reduce corporate value [10].

8.4. The distinctive nature of cross-border regulatory risks

The difference in the cross-border regulatory framework exacerbates the risk of fraud in highly concentrated equity companies [11]: the cross-border capital transfer of Luckin Coffee has caused the failure of the internal control system, and the lack of cross-border audit has led to a surge in fraud after the IPO. Law enforcement information barriers exacerbate the concealment of fraud - companies operate in jurisdictions with weak supervision and use differences in legal standards and law enforcement to evade supervision [11]. Cross-border listed companies face double regulatory pressure, and the inconsistency of information disclosure requirements creates "supervisory arbitrage" space - controlling shareholders manipulate financial data across jurisdictions, which increases the difficulty of fraud detection [11]. It is worth noting that there are differences in the law and economics of self-transaction between countries, which will affect the regulatory risks of cross-border enterprises [11].

9. Governance optimization and risk mitigation strategies

9.1. Equity structure dynamic optimization

In order to alleviate the escalation of nonlinear risks, start-ups must implement a dynamic rebalancing mechanism. This includes the strategy of diluting equity in stages to ensure that the company will not be in the "solidification zone" for a long time. In addition, the implementation of the "sunset clause" for the dual equity structure can effectively reduce the risk curve and prevent the permanent decoupling of control from ownership: in the seed round/early growth stage, maintain the appropriate founder control (40%-60% equity ratio) to ensure decision-making efficiency, while introducing industry resources Strategic investors lay the foundation for the checks and balances mechanism of corporate governance [8]; in the expansion stage, gradually dilute the equity through multiple rounds of financing, control the equity ratio of the founder at 30%-40%, and increase the shareholding ratio of institutional investors (≥ 25%) to enhance the supervisory ability [5]; in the pre-IPO stage , optimize the equity structure, so that the equity ratio of the founder is 20%-30%, the shareholding ratio of institutional investors is ≥ 35%, and the public shareholding ratio is ≥ 25%, thus forming a multi-party balance model [3].

Special equity arrangement governance includes setting sunset clauses for the double equity structure (for example, automatically converted to a single equity after 10-15 years or when the founder's equity ratio is less than 10%) to avoid permanent control [12]. In addition, the voting rights entrustment agreement must be regulated by clarifying the scope, duration and revocation conditions to prevent excessive concentration of control [4].

9.2. Internal control system improvement

In order to match the dynamic equity structure, it is necessary to establish a sound internal control and governance mechanism to prevent the decoupling of control from the company's long-term interests. The focus is on the governance of special equity arrangements: the company should implement the "sunset clause" for the dual equity structure, for example, after 10-15 years or when the founder's shareholding ratio is less than 10%, it will be automatically converted into a single equity structure to prevent permanent control [12]. In addition, it is necessary to standardize the voting agency agreement and clearly define its scope, duration and revocation conditions to reduce the risk of excessive concentration of power [3].

9.3. External supervision and institutional environment improvement

Regulatory policy optimization: improve the information disclosure requirements of equity concentration, and require start-ups to disclose the control structure, cash flow and control deviation, and special equity arrangements in financing prospectus and annual reports [11]; strengthen cross-border supervision and coordination, and establish information sharing and joint law enforcement between Chinese and foreign regulatory agencies. System, crack down on cross-border financial fraud [11]; through measures such as criminal liability, civil compensation and market bans, increase the cost of illegal acts and severely punish fraud [7].

Strengthen market supervision: encourage institutional investors to play an active supervisory role and support shareholder proposals and the exercise of voting rights to restrain the behavior of controlling shareholders [5]; cultivate professional third-party governance institutions to provide equity structure design, internal control consulting and fraud risk assessment services for start-ups [6].

9.4. Stakeholder governance collaboration

Founders should establish the governance concept of "value sharing", balance control with the long-term development of the company, and avoid using control advantages for personal gain [1]; Investors should strengthen post-investment management, participate in corporate governance through board seats, veto and supervisory agreements, and urge start-ups to improve their internal control system [8]; Employees should establish a reporting mechanism to protect the legitimate rights and interests of whistle blowers in order to detect internal control defects and fraud risks in a timely manner [6]; regulators, investors, intermediaries and other stakeholders should build a joint governance network to improve governance efficiency through information sharing and collaborative supervision [11]. Jensen and Meckling believe that company theory emphasizes the importance of stakeholder cooperation in reducing agency costs [2].

10. Conclusion and future prospect

10.1. Research conclusions

This study systematically explores the impact of the high concentration of equity in high-growth start-ups on the effectiveness of internal control and the risk of financial fraud, and draws the following core conclusions:

First of all, the equity concentration of high-growth start-ups shows the characteristics of stage evolution. In the seed, growth and expansion periods, the equity concentration gradually transitions from "single-dominated" to "institutional balance", but excessive concentration at all stages will lead to an imbalance in the corporate governance structure. When identifying high concentration, a variety of indicators should be comprehensively considered, such as the Huffindal-Herchmann Index (HHI), the voting threshold and the control mechanism, to avoid a single indicator deviation.

Secondly, the high concentration of equity affects the effectiveness of internal control through four mechanisms: regulatory failure based on the agency theory, governance imbalance based on the theory of trusted responsibility, information disclosure deviation, and regulatory loopholes based on the institutional framework. These mechanisms interact to weaken the internal control system and create institutional conditions for financial fraud.

Third, the comparison of cross-border cases shows that the evolution path of equity concentration risk of Chinese and American start-ups is affected by the institutional and regulatory environment. Chinese start-ups face more prominent risks of control disputes and regulatory lag, while U.S. start-ups are subject to the long-term governance rigidity caused by the dual equity structure. The nonlinear risk model between equity concentration and financial fraud has been verified through multiple quantitative models, among which core indicators such as DSRI, AQI and operating cash flow can effectively identify fraud risks.

Fourth, the multi-dimensional impact of risk shock includes resource allocation distortion, operational efficiency decline, brand value erosion and cross-border regulatory risks. Governance optimization requires joint efforts in many aspects such as equity restructuring, internal control improvement, external supervision strengthening and stakeholder collaboration to form a phased and multi-level risk mitigation system.

10.2. Research limitations and future prospects

This research has some limitations: first, the cross-border cases covered by the sample are limited, and future research can expand the sample range and include start-ups in Europe, Southeast Asia and other regions to enhance the universality of the conclusion; second, quantitative verification relies on traditional financial models, and future research can integrate machine learning and big data. Technology, build a more accurate

fraud risk prediction system, and incorporate non-financial indicators such as governance structure and management characteristics; Third, this study focuses on the direct impact of equity concentration. Future research can explore the regulatory role of factors such as industry attributes, entrepreneur characteristics and institutional environment to deepen the understanding of risk transmission mechanism solve.

Future research directions can also include: exploring the impact of different types of equity concentration (founder control, institutional investor control, family control) on internal control and fraud risk; investigating the long-term effect of governance optimization measures by tracking the growth cycle of start-ups; studying the impact of digital transformation on equity concentration and The impact of internal control effectiveness provides new ideas for the governance of high-growth start-ups in the digital economy era.

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