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# Detecting financial statement fraud in listed companies using financial econometric models: the case of Luckin Coffee Inc.

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**Abstract.** This paper examines how financial econometric models can be used to identify financial statement fraud in listed companies, using Luckin Coffee Inc. as a case study. Luckin Coffee was selected because it is a well-known publicly listed company whose accounting scandal has been documented by regulatory authorities, while its rapid-growth business model provides a suitable setting for quantitative fraud-risk analysis. The study combines a qualitative analysis of the mechanisms underlying the fraud with a concise empirical assessment based on the Beneish M-score and accrual-based indicators. The results reveal several measurable warning signs in the company's reporting environment in 2019, including abnormal sales growth, a widening gap between reported revenue and operating cash flow, inflated costs and expenses used to support fictitious sales, and increased leverage pressure following aggressive external financing. Even when the unstable accounts receivable ratio is treated conservatively, the resulting M-score remains above commonly used thresholds for manipulation risk. The study argues that financial econometric models cannot replace audit evidence, but they can serve as an effective early-warning tool for investors, auditors, and regulators. The primary contribution of this study is to demonstrate how model-based screening can be integrated with governance analysis into a practical framework for detecting fraud in listed companies.

**Keywords:** financial fraud, listed companies, Beneish M-score, earnings management, Luckin Coffee Inc.

## 1. Introduction

Financial statement fraud is one of the most damaging risks in capital markets because it distorts valuation, misleads investors, and undermines confidence in audited financial information. The problem is particularly significant for high-growth listed companies, as market expectations may encourage rapid expansion before a sustainable profit model has been established. Luckin Coffee Inc. provides a representative and influential case in this regard. The Chinese coffee chain was listed on the Nasdaq in 2019. In December 2020, the U.S. Securities and Exchange Commission (SEC) charged Luckin Coffee with materially misrepresenting its revenue, expenses, and net operating loss. The company agreed to pay a $180 million penalty without

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admitting or denying the allegations.[1] Luckin Coffee subsequently disclosed that the fabricated transactions had begun in April 2019, resulting in an overstatement of approximately RMB 2.12 billion in net revenue and RMB 1.34 billion in costs and expenses for 2019.[2]

The research question addressed in this paper is: How can financial econometric models be used to identify the risk of financial statement fraud in listed companies? Luckin Coffee is selected as the case study because the scandal has received extensive public attention, reliable official disclosures are available, and the company's business model resulted in financial ratios exhibiting pronounced abnormalities. While a purely narrative discussion can explain the development and consequences of the scandal, a finance-oriented study should also examine whether abnormal financial patterns could have been detected at an earlier stage. Accordingly, this paper analyzes Luckin Coffee's financial statements for 2018 and 2019 using the Beneish M-score, accrual-based indicators, and cash-flow consistency analysis. The objective is not to independently establish fraud in the legal sense, as legal determinations depend on documentary evidence, intent, and investigative findings. Rather, the study seeks to assess whether financial econometric screening could have generated strong warning signals before or around the time the scandal was disclosed.

This study has both practical and academic significance. For investors, model-based screening can strengthen due diligence when a company reports exceptionally rapid sales growth. For auditors, such models can support risk assessment and the design of substantive testing procedures. For regulators, they can help prioritize companies for further review. From an academic perspective, the case illustrates both the effectiveness and limitations of fraud-detection models when applied to emerging growth companies with relatively short listing histories and subsequently restated financial data.

## 2. Background and literature review

Research on financial misconduct generally distinguishes between earnings management, which may occur within the flexibility permitted by accounting standards, and fraudulent financial reporting, which involves intentional material misstatements. The Beneish Earnings Manipulation Model is one of the most widely cited quantitative screening tools in this field. The model employs eight financial ratios to capture changes in accounts receivable, profit margins, asset quality, sales growth, depreciation, selling and administrative expenses, leverage, and accruals [1]. A higher M-score indicates a greater likelihood of earnings manipulation. Although the model was originally developed using data from U.S. companies, its underlying logic is also applicable to internationally listed firms because manipulation often leaves similar accounting footprints, such as sales growth outpacing cash-flow growth, deteriorating asset quality, and abnormal accrual behavior.

Accrual-based earnings management models provide another important foundation for fraud detection. Jones developed a discretionary accrual framework to estimate the normal relationships among accruals, changes in sales, and property, plant, and equipment [2]. Dechow et al. subsequently evaluated alternative models and emphasized that, although accrual-based models are useful, their effectiveness is sensitive to model specification and firm performance [3]. More recently, Dechow et al. developed a broader model for predicting material accounting misstatements, demonstrating that misstatement risk is associated with both accounting signals and managerial incentives [4]. These studies suggest that effective fraud-risk assessment should not rely on a single financial ratio but should instead integrate accounting variables, cash-flow analysis,

1 Source: https://www.sec.gov/newsroom/press-releases/2020-319?utm_source

2 Source: https://www.sec.gov/Archives/edgar/data/1767582/000110465921087180/a20-36633_120f.htm?utm_source

and the corporate governance context.

Fraud theories also help explain why companies may manipulate their financial statements. Cressey's fraud triangle identifies pressure, opportunity, and rationalization as the key conditions underlying occupational fraud [5]. In the case of Luckin Coffee, pressure arose from rapid expansion, capital-market expectations, and the perceived need to support the valuation of a technology-driven retail business. Opportunities for manipulation were created by the large volume of small transactions, coupons, online orders, and related-party procurement arrangements, which made fictitious sales more difficult to detect. Rationalization may have stemmed from a growth-oriented corporate culture in which reported scale appeared to be valued more highly than short-term profitability. The guidance issued by COSO and the ACFE likewise emphasizes that conventional internal controls over accounting accuracy may be insufficient to address fraud unless risk assessments explicitly consider specific fraud risks, including management override of controls and collusion [6].

## 3. Main content

### 3.1. Methodology and data

This study adopts a single-case study design supplemented by financial econometric indicators. The data are derived from Luckin Coffee's 2019 Form 20-F and related restatement disclosures. Key variables include total net revenue, accounts receivable, current assets, property, plant, and equipment, total assets, liabilities, depreciation and amortization, selling and marketing expenses, general and administrative expenses, net loss, and operating cash flow. Because Luckin Coffee restated its 2019 financial data following an internal investigation, this analysis uses the restated annual figures to assess whether its business model continued to exhibit indicators of risk. Accordingly, the analysis poses a relatively conservative question: Even after the financial statements were corrected, did the company's financial position still exhibit signs of manipulation risk?

The primary quantitative tool employed is the Beneish M-score. The standard eight-variable specification is Equation (1):

$$M = -4.84 + 0.920DSRI + 0.528GMI + 0.404AQI + 0.892SGI + 0.115DEPI \quad (1)$$
$$-0.172SGAI + 4.679TATA - 0.327LVGI$$

In Equation (1), DSRI denotes the Days' Sales in Receivables Index, GMI the Gross Margin Index, AQI the Asset Quality Index, SGI the Sales Growth Index, DEPI the Depreciation Index, SGAI the Sales, General and Administrative Expenses Index, TATA the ratio of Total Accruals to Total Assets, and LVGI the Leverage Index [1]. A commonly used interpretation is that an M-score above approximately −2.22 indicates a relatively high likelihood of earnings manipulation. However, the Luckin Coffee case presents a technical limitation: the company reported zero accounts receivable in 2018 but RMB 22.8 million in 2019, making the DSRI mechanically unstable. To avoid generating an artificially infinite value, this study treats DSRI separately as a warning signal and caps its contribution to the composite score at 1.0. This represents a conservative treatment because a higher DSRI would only increase the estimated manipulation-risk score.

### 3.2. Econometric indicators and research findings

The key indicators calculated from Luckin Coffee's publicly disclosed financial statements show that the strongest warning signals were not conventional accounts receivable inflation, but rather explosive sales growth, rising leverage, and a pronounced disconnect between revenue expansion and operating cash flow.

The Sales Growth Index (SGI) was approximately 3.598, indicating that Luckin Coffee's revenue increased by more than 3.5 times in 2019 compared with 2018. This constitutes a classic pressure signal in fraud screening because listed companies experiencing exceptionally rapid growth may face stronger incentives to sustain market expectations.

The Gross Margin Index (GMI) was approximately 0.792, indicating an improvement rather than a deterioration in gross margins. Taken in isolation, this would reduce the perceived risk of manipulation under the Beneish framework. In Luckin Coffee's case, however, the interpretation is more complicated. The company consistently emphasized technology-driven efficiency and economies of scale, making improved margins appear broadly consistent with its business narrative. However, after the accounting scandal came to light, Luckin Coffee acknowledged that not only its revenue but also its costs and expenses had been overstated. This suggests that certain conventional profitability ratios may not fully capture the manipulation because the fictitious revenue was supported by fictitious expenses.

The Asset Quality Index (AQI) was approximately 0.640, while the Depreciation Index (DEPI) was approximately 0.602. Neither indicator showed a significant signal of manipulation. This is important because it demonstrates that not all components of the model point in the same direction. Fraud detection should not be based simply on selecting individual ratios; rather, the overall pattern should be considered. In Luckin Coffee's case, the most important model-driven factors were sales growth, leverage pressure, instability in accounts receivable, and volatility in operating cash flow.

The Sales, General and Administrative Expenses Index (SGAI) was approximately 0.574, indicating a substantial decline in selling, general and administrative expenses as a proportion of sales. At first glance, this appears to support the company's claim that it had achieved operating leverage. However, when revenue is growing at an exceptionally rapid rate while cash flow remains negative, such a pattern may also warrant scrutiny. The Leverage Index (LVGI) was approximately 1.454, indicating that liabilities were growing faster than assets. This suggests increasing financial pressure on the company. Finally, Total Accruals to Total Assets (TATA) was approximately −0.102, reflecting substantial losses and operating cash outflows. The conservative Beneish M-score was approximately −1.015, which is above the commonly used threshold of −2.22 and therefore indicates a potential risk of earnings manipulation.

## 4. Discussion

The M-score results are significant because they show that even a conservatively specified model would classify Luckin Coffee as a high-risk company. Among the individual components, the Sales Growth Index was the most influential driver. In conventional financial analysis, high sales growth is not necessarily suspicious; rapidly growing companies may genuinely be successful. However, in fraud-detection models, exceptionally high growth can create both pressure and opportunity. Management may face strong incentives to maintain market expectations, particularly following an IPO and subsequent financing activities. The U.S. Securities and Exchange Commission (SEC) reported that Luckin Coffee raised more than $864 million from debt and equity investors during the period in which the fraud occurred. This financing context makes the sales-growth signal more meaningful because reported growth can influence investor perceptions and access to financing.

The second major finding concerns the cash-flow inconsistency. Luckin Coffee reported net revenue of RMB 3.02 billion in 2019, compared with RMB 840.7 million in 2018, while its operating cash flow remained negative at RMB 2.17 billion in 2019. Negative cash flow is not, in itself, evidence of fraud, as young companies may consume substantial amounts of cash during periods of expansion. Nevertheless, such a large

divergence between rapidly increasing revenue and persistent operating cash outflows should prompt further investigation. A credible high-growth retail model should eventually demonstrate improving cash conversion, or at least provide a transparent explanation for why cash collection consistently lags behind reported sales. In Luckin Coffee's case, subsequent investigations revealed that fictitious sales were supported by inflated expenses, fabricated operating data, and manipulated records. This is precisely the type of pattern that model-based screening is designed to flag.

The third finding concerns the role of costs and expenses. In some fraud cases, companies overstate revenue without corresponding expense structures, resulting in implausibly high profit margins. Luckin Coffee's case was more complex because its expenses were also overstated. According to the company's own restatement disclosures, its costs and expenses were overstated by RMB 1.34 billion in 2019. This made the fictitious sales appear operationally plausible. From a modeling perspective, this means that gross margins and selling, general and administrative expense ratios may not have appeared as suspicious as expected. Consequently, relying solely on profitability ratios could underestimate the underlying risk. A more effective approach is to combine the M-score with forensic audit procedures: verifying whether suppliers actually existed, determining whether coupon redemption data were consistent with cash receipts, examining related-party transactions, and reconciling bank records with platform sales data.

The case also highlights the limitations of accrual-based models. The Jones model and modified accrual-based approaches are effective in detecting earnings management conducted through conventional accrual accounts, such as accounts receivable, inventories, depreciation, and provisions [2, 3]. Luckin Coffee's manipulation, by contrast, involved fabricating retail transactions and inflating expenses. Because many of these transactions were relatively small and conducted electronically, the problem was not simply a matter of discretionary year-end accruals but rather operational-data fraud involving sales systems, counterparties, and cash records. This supports the argument advanced by Dechow et al. that misstatement prediction should integrate accounting variables with managerial incentives and institutional conditions [4]. In short, econometric models can identify risk, but forensic audit procedures are required to establish the underlying mechanism.

The governance analysis further reinforces this interpretation. The fraud triangle suggests that pressure, opportunity, and rationalization must be considered together [5]. Following its IPO, Luckin Coffee faced pressure arising from capital-market expectations, opportunities created by rapid expansion and the complexity of digitally mediated transactions, and potential rationalization stemming from a strategy that prioritized scale. Internal control issues were also significant. Luckin Coffee's 2019 Form 20-F stated that, under the transition rules applicable to newly public companies, management's annual report on internal control over financial reporting and the auditor's attestation report were not included. This does not mean that the company had no internal controls, but it indicates that public investors had limited external assurance regarding the effectiveness of its internal controls during a period of rapid business expansion. The guidance issued by COSO and the ACFE would treat such circumstances as warranting a more rigorous fraud-risk assessment rather than merely routine accounting controls [6].

## 5. Challenges

The primary challenge of this study concerns data quality. Luckin Coffee's original quarterly financial statements for 2019 were subsequently restated, meaning that the use of the original data could exaggerate or duplicate the effects of the manipulation that were later established. Using the restated annual data provides a more conservative approach, but it also reduces the model's ability to reproduce the precise warning signals

that would have been available to investors before the scandal was exposed. The second challenge is the short time series. As Luckin Coffee had only a relatively brief history as a listed company, there were few pre-fraud years of publicly available data that could be used for regression estimation. This makes a full panel econometric model impractical for a 2,500-word paper. The third challenge concerns model portability. The Beneish model was developed using historical data from U.S. companies, whereas Luckin Coffee is a Chinese company listed in the United States. Business models, accounting environments, and regulatory conditions differ across markets. For these reasons, this study uses the model as a screening tool rather than as a deterministic classification instrument.

Another challenge is that certain indicators can become unstable for high-growth companies. For example, when accounts receivable are zero in the preceding year, calculating the DSRI becomes problematic. A mechanical calculation may produce an apparently precise but economically unreliable extreme value. The solution adopted here is to disclose this limitation, cap the contribution of the ratio to the composite score, and discuss the change in accounts receivable separately. This approach is more transparent and avoids overstating the precision of the analysis.

## 6. Lessons learned and implications

First, fraud detection should begin with business logic. Luckin Coffee's corporate narrative was compelling, emphasizing technology, delivery services, coupons, and rapid store expansion. However, when a company's valuation depends heavily on growth, its reported sales should be cross-checked against actual cash receipts, customer behavior, and third-party evidence. Financial models are useful because they require researchers to compare information across different financial statements rather than simply accepting management's explanations at face value.

The second lesson is that no single model is sufficient to address every case. The M-score correctly identified a heightened risk of manipulation, primarily driven by exceptionally rapid sales growth and substantial leverage pressure.

The third lesson is both personal and methodological. Conducting rigorous research in finance requires more than simply summarizing a well-known scandal. A stronger study should formulate a clear research question, construct an appropriate model, state its assumptions transparently, and acknowledge its limitations. In this case, the model cannot replace an investigation by the U.S. Securities and Exchange Commission (SEC), but it helps explain why Luckin Coffee's financial statements should have appeared risky from an investor's perspective. More broadly, financial econometrics can make fraud research more objective, particularly when quantitative analysis is integrated with institutional and governance analysis.

## 7. Conclusion

This study applies financial econometric models to analyze the financial statement fraud case of Luckin Coffee, a listed company. The evidence indicates that the company's financial position in 2019 exhibited multiple warning signals, including abnormal sales growth, persistent negative operating cash flow, increasing leverage pressure, fluctuations in accounts receivable, and inflated expenses used to support fictitious revenue. The conservative Beneish M-score was approximately −1.015, above the commonly used threshold for manipulation risk, indicating that model-based screening would have classified Luckin Coffee as a high-risk company. At the same time, the case exposes the limitations of quantitative models. Because the fraud involved fabricated transactions and manipulated operating data, effective detection requires not only ratio analysis but also in-depth forensic testing of cash flows, counterparties, and internal systems. Overall,

financial econometric models are valuable early-warning tools for investors, auditors, and regulators, but they should be used as part of a comprehensive fraud-risk assessment framework rather than treated as standalone evidence of fraud.

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