Financial Fraud Prediction Models: A Review Of Research Evidence

V.K.Wadhwa, A.K.Saini, S.Sanjay Kumar

Abstract: Despite reports about significant advances in techniques for prediction of financial frauds research findings till now do not provide specific evidence or tools for predicting frauds that could be averted. Researchers have explored different methods with varied degree of success relying on financial data as well as non-financial factors for their purpose. This paper reviews reported models/evidence including adaptations/improvements in the models used during investigation. Fraud triangle theory specified by Cressey in 1953 is at the foundation applied in empirical predictive modelling postulated by a number of researchers. Prominent contributors are Beasley, M.S. (1996)., Dechow, et al. (1996).,Beneish M. D. (1997)., Nieschwietz et al. (2000), Skousen and Wright (2008). Convergence of fraud triangle theory to fraud diamond theory was suggested by Wolf and Hermanson in 2004. This paper additionally reviews specific computational models known as Z-Score (Altman,1968), M-Score (Beneish, 1999, 2012), and computer software based models from Green B.P. & Choi J.H.(1997) Zaki & Theodoulidis (2013) and Arta & Seyrek, (2009). There is a noticeable changing trend in research going towards numerous investigations now using computer supported machine learning and artificial intelligence tools for prediction of financial frauds. At the end an assessment is made about degree of success achieved in prediction of financial frauds till date. Empirical fraud prediction, Fraud Triangle/Diamond, M-Score, Z-Score, Machine Learning & Artificial Intelligence for fraud prediction.

Index Terms: Empirical fraud prediction, Fraud Triangle/Diamond, M-Score, Z-Score, Machine Learning & Artificial Intelligence for fraud prediction.

1. INTRODUCTION

THIS review finds out the extent and effectiveness of models used for detection/prediction of financial frauds. An attempt is made to compile available literature connected with prediction of financial frauds. It is assumed that forecast of any phenomenon is dependent on a number of inputs which also interact inter-se in a complex manner. Hence visible outcome may conceal underlying causes. The challenge is to discover well in advance the possibility of occurrence of a financial fraud. To predict occurrence of financial fraud from time to time number of factors, evident, non evident, hidden have been explored by researchers with varying degree of success. Most common and classical method relies on empirical analysis to trace the possibility of fraudulent behaviour. The following part of this paper contains individual sections separately devoted to each model found in the research. Firstly proponents of empirical prediction of financial frauds through a set of observable fraud cues are reviewed. Secondly computational models based on financial information are reviewed. These are primarily two models i.e. M-Score and Z-Score. Lastly, machine learning/artificial intelligence as a tool to predict financial frauds is reviewed.

1.1 Empirical Research on prediction of financial frauds:-

A set of predetermined standard steps/procedure cannot be applied to predict financial frauds. Auditors generally are trained to routinely follow certain standard procedure to improve effectiveness of auditing. Nieschwietz et al. (2000) reported that check lists used by auditors provide an insight into the likelihood of financial fraud. The authors further discuss that the environment in which auditors operate is assessed through the checklist and research on the predictors of fraud centres around empirical tests of validity of fraud indicators. Evidence is also presented by the authors about the detailed fraud risk assessment undertaken by the auditors at the planning stage of auditing process. Nieschwietz et al. (2000) observed in this context of auditing that the professional requirements of an auditor ensures to put in place a fraud risk management program consisting of written policies of fraud risk measurement. The scale of such measurement may include objective computation of fraud risk score or some kind of fraud risk index which is essentially in quantitative terms. The research aims to examine and get empirical evidence with respect to internal control and internal auditing. Core structure of internal auditing alongwith design of management control system plays a crucial role in measurement of likelihood of financial fraud is pointed out by the authors in the research paper. Consistent with the aforesaid finding Albrecht and Romney (1986) published their first empirical study establishing major role of red flags to predict financial frauds. Authors in their research paper entitled "Red-flagging management frauds: A validation" documented the evidentiary value of red flags for prediction of financial frauds. Surveys conducted by authors demonstrated effectiveness of red flagging to predict financial frauds. Finding of the researchers prove relevance of formation of Ex-ante warning signs of a possible financial fraud. Contribution of the authors provides attributes to red flags in predicting financial frauds. Inference of researchers support relevant professional knowledge is the key to development of mechanism of prediction of financial frauds. The study of Albrecht and Romney (1986) further argues that frauds are inherent in the organisations and skilful people can at the most reduce the likelihood of financial frauds. Financial frauds cannot be completely eliminated. Association of Certified Fraud Examiners (ACFE) is an anti-fraud organisation situated in USA providing training and education. ACFE has conducted detailed studies of fraudulent occurrences of financial statement frauds to recognize such financial statement which are manipulated. ACFE has also enlisted some of the most frequently used tactics to perpetuate frauds in financial statements. Financial statements can be manipulated in various ways. ACFE has declared one of top most cause of fraudulent manipulation is greed and secondly it is the work pressure. Causes identified by ACFE include two prime circumstantial factors which are firstly 'when it is easy to do it' and secondly 'when it is unlikely that perpetrator will get caught'. ACFE enlisted five basic types of financial statement frauds as under:

Table-1: *Types of financial frauds*

S.No	Type of fraudulent activity
1.	Fictitious sales
2.	Improper expense recognition

3.	Incorrect asset valuation
4.	Hidden Liabilities
5.	Unsuitable disclosures

These kinds of activities are planned in such a way that they are difficult to trace in the normal course of audit. Only comprehensive forensic audit may bring such activities to light. ACFE enlisted the following red flags for fraud risk examiners

***Table-2**: Red Flags*

S.No.	Basis of Fraud Red Flag
1.	Growth in revenues without matching rise in cash flows
2.	Steady sales growth although well-known competitors are facing though time.
3.	Baffling rise in sale along with growing inventories. Useless stock of goods may be shown as future sale.
4.	Rising profit margin whereas the industry is in downtrend.
5.	Overstated life of fixed assets. Change in accounting policies without genuine reasons.
6.	Weak internal audit and control.
7.	Frequent violation of terms and conditions of loan or at the verge of default.
8.	Replacement of auditors without genuine reasons.
9.	Related party transaction not disclosed to auditors.
10.	Different ratios of financial statement over a period of time.

1.2 Fraud Triangle as predictor of financial frauds:-

Empirical research on frauds goes back to 1953 when Cressey presented with the idea of fraud triangle (Cressey, D 1953). The three aspects of fraud triangle are (i) Opportunity, (ii) Pressure and (iii) Rationalisation. Empirical research suggests that the three components of triangle can be broken down to specific measurable items and then possibility of financial frauds can be deduced from the items. These items can be called proxies of the three corners of the fraud triangle. Skousen et al. (2008) evaluated influence of fraud triangle through proxies of one part of triangle called Pressure by subdividing the concept of pressure by way of computation of (i) Gross profit margin (ii) change in sales of the company in comparison to the average change in the industry and (iii) percentage change in the assets for the two years prior to fraud. The authors say that the company face pressure to commit fraud when financial stability or profitability is under threat. The threat may be due to external factors. Albrecht (2002) suggested that sales to accounts receivable ratio along with sales to total assets ratio and inventory to total sales represent pressure. Proxies of external pressure refer to demand for financing vis-a-vis internal cash generation (Dechow et al. 1996) adjusted by cash dividend and capital expenditure. Thus it can be stated that the pressure in terms of financial performance is whether the company is in a position to meet its financial targets or not. Opportunity is the next factor of fraud triangle. Proxies of 'Opportunity' refer to ineffective internal control system. Variable to measure opportunity include firstly the percentage of board members who are outside member. Oversight of audit committee by an independent member of board is known to have reduced incidence of fraudulent behaviour (Beasley et al. 2000). Proxies of 'Rationalization' proxies include the excessive use of discretionary accruals and the resultant qualified audit reports. Fraud diamond theory was first presented by Wolfe and Hermanson (2004) who added one more dimension to fraud triangle theory by adding capability as fourth aspect of motivation for incidence of frauds. It means that the perpetuator of financial fraud must have the necessary skill and ability to commit fraud.

2 COMPUTATIONAL MODELS:-

2.1 ALTMAN Z-SCORE MODEL AS PREDICTOR OF FINANCIAL FAILURE:-

Altman published Z-Score formula in 1968. It is a computational method of predicting if the firm is likely to be bankrupt within next two years. The formula given by Altman is :-

$$Z=1.2(T1)+1.4(T2)+3.3(T3)+0.6(T4)+0.999(T5)$$

Where:
T1 = Working Capital/Total Assets
T2= Retained Earnings/Total Assets
T3=Earnings Before Interest and Taxes/Total Assets
T4=Market Value of Equity/Total Liability
T5=Sales/Total Assets

If Z is greater than 2.99 it is considered safe zone and if Z is between 1.81 to 2.99 it is considered grey zone and if Z is less than 1.81 it is considered distress zone.

If the firms happens to be unlisted not having a market value than the market value gets substituted with book value of the firm. Similarly there will be small modification in the formula for non-manufacturing companies and financial sector companies. Altman Z-score would have predicted in advance fraudulent behaviour of Enron as per the published financial statements of Enron. In this it was established that financial failure could have been predicted with the publically available published financial statements.

2.2 BENEISH M-SCORE MODEL FOR PREDICTION OF FINANCIAL FRAUDS RELATING TO EARNINGS MANIPULATION:-

Professor M Danial Beneish from Kelley School of Business published a path breaking research paper in 1999. He found out that a set of financial ratio and eight variables can identify financial frauds relating to earning manipulation. Since all the required input is obtainable from the published financial statements of the company the whole process of prediction becomes very practical and convenient. The variables used in computation of M-score are as under:-

S.No.	Variable	Meaning of Variable
1.	DSRI	Days' sales in receivable index
2.	GMI	Gross margin index
3.	AQI	Asset quality index
4.	SGI	Sales growth index
5.	DEPI	Depreciation index
6.	SGAI	Sales and general administrative. Expenses
7.	LVGI	Leverage index
8.	TATA	Total accruals to total assets

If M-Score is less than -2.22 it shall mean company has not manipulated earnings and M-Score greater than 2.22 shall mean there is a good chance of manipulation of earnings. This model has been applied all over the world by a large number of other researchers confirming reasonable accuracy of the model. Results obtained in India are not much at variation.

3 COMPUTER BASED ADVANCED SOFTWARES:-

3.1 MACHINE LEARNING/ARTIFICAL INTELLIGENCE/DATA MINING (HEREIN AFTER ML/AI/DM) FOR PREDICTION OF FINANCIAL FRAUDS:-

Sharma A and P.K.Panigrahi (2012) has observed that advancement of computer technology has brought about major change in methods of prediction of financial frauds. They have noted that ML/AI/DM have occupied a centre stage now in devising procedures for prediction of financial frauds. ML/AI/DM methods are divided into two categories of models called supervised methods and unsupervised methods. Green and Choi (1997) presented in their research article entitled “Detecting management fraud through neural network technology” a technique to find out fraudulent activity from the published financial statements. Green and Choi (1997) initially from the data of fraud firms fed input values to the machine learning software in order to train the software subsequently the trained software were applied on raw data to filter possibility of incidence of financial frauds. The process involves feeding of data to the machine for the machine to learn and subsequently apply the learnt algorithm to test the unknown situation to show generalised rules being applied for prediction of financial frauds. Consistent with Green and Choi (1997), Juszezak et al.(2008) concluded the problem of prediction of financial frauds can be considered as a problem of classification. By classifying unknown firms in two parts as fraudulent firms and non fraudulent firms we can predict that a firm is likely to engage in fraudulent activity or not. Authors pointed out that the machine learning models improve their performance with experience. In some cases the coefficient are computed at the time of feeding of data and in some other cases the processing is lazy because the updating is done while the data is being processed.

3 CONCLUSION:

Varied models examined in this paper provide inclusive evidence about the most accurate method of prediction of financial fraud. Most of the models lack generalisation potential because of over dependency on small size of data. All the models are highly data bias and therefore low in generalisation. It is a serious limitation which can be overcome only if large data size is available for dispensation. Finally it can be concluded that none of model could provide perfect solution for prediction of financial frauds and there is a lot yet to be done. However future is quite promising in view of available latest tools particularly machine learning and artificial intelligence is titivating all along.

REFERENCES

[1] A. Sharma and P. Kumar Panigrahi, (2012) review of financial accounting fraud detection based on data mining techniques, International Journal of Computer Applications, vol. 39, no. 1, pp. 37–47.
[2] Abbott, L.J., S. Parker, and G.F. Peters. 2004. Audit Committee Characteristics and Restatements. Auditing: A Journal of Practice & Theory 23: 69-88.
[3] Aghghaleh, S.F., Z.M. Mohamed, and M.M. Rahmat. 2016. Detecting Financial Statement Frauds in Malaysia: Comparing the Abilities of Beneish and Dechow Models. Asian Journal of Accounting and Governance 7: 57-65.
[4] Albrecht, W. S. and M. B. Romney (1986) Red-flagging management fraud: A validation. Advances in Accounting 3: 323-334
[5] Altamuro, J., A. L. Beatty, and J. Weber. 2005. The Effects of Accelerated Revenue Recognition on Earnings Management and Earnings Informativeness: Evidence from SEC Staff Accounting Bulletin No. 101. The Accounting Review 80: 373-401.
[6] Altman, E.I. 1968. Financial Ratios, Discriminant Analysis and the Prediction of Corporate Bankruptcy. The Journal of Finance 23 (4): 589-609.
[7] American Institute of Certified Public Accountants (AICPA). 1997. Considerations of Fraud in a Financial Statement Audit Statement on Auditing Standards No. 82. New York, NY: AICPA.
[8] American Institute of Certified Public Accountants (AICPA). 2002. Considerations of Fraud in a Financial Statement Audit Statement on Auditing Standards No. 99. New York, NY: AICPA.
[9] Baucus, M.S. & Near, J.P. 1991. Can illegal corporate behaviour be predicted? An event history analysis. Academy of Management Journal. 34(1):9-36.
[10] Bayley, L., & S.L. Taylor. 2007. Identifying Earnings Overstatements: A Practical Test. Working paper.
[11] Beasley, M. S., Carcello, J. V., Hermanson, D. R., & Lapides, P. D. (2000). Fraudulent financial reporting: Consideration of industry traits and corporate governance mechanisms. Accounting Horizons, 14(4), 441-454.
[12] Beasley, M.S. 1996. An Empirical Analysis of the Relation Between the Board of Director Composition and Financial Statement Fraud. The Accounting Review 71: 443-465.
[13] Beasley, M.S. 1996. An empirical analysis of the relation between the board of director composition and financial statement fraud. The Accounting Review 71 (October): 443-464
[14] Beasley, M.S., J.V. Carcello, and D.R. Hermanson. 1999. Fraudulent Financial Reporting: 1987-1997. An Analysis of US Public Companies. Committee of Sponsoring Organizations of the Treadway Commission (COSO)
[15] Beasley, M.S., J.V. Carcello, D.R. Hermanson, and T.L. Neal. 2010. Fraudulent Financial Reporting: 1998-2007. An Analysis of US Public Companies. Committee of Sponsoring Organizations of the Treadway Commission (COSO)
[16] Bell, T.B., and J.V. Carcello. 2000. A Decision Aid for Assessing the Likelihood of Fraudulent Financial Reporting. Auditing: A Journal of Practice & Theory 19 (1): 169-184.
[17] Beneish, M.D. 1999. The Detection of Earnings Manipulation. Financial Analysts Journal 55 (5): 24-36.
[18] Bhasin M. L. (2012). Corporate Accounting Frauds: A Case Study of Satyam
[19] Bonner, S.E., Z-V. Palmrose, and S.M. Young. 1998. Fraud Type and Auditor Litigation: An Analysis of SEC Accounting and Auditing Enforcement Releases. The Accounting Review 73 (4): 503-532. 89
[20] Brazel, J.F., K.L. Jones, and M.F. Zimbelman. 2009. Using Nonfinancial Measures to Assess Fraud Risk. Journal of Accounting Research 47 (5): 1135-1166.
[21] Brazel, J.F., K.L. Jones, J. Thayer, and R.C. Warne. 2015. Understanding Investor Perceptions of Financial Statement Fraud and their Use of Red Flags: Evidence from the Field. Review of Accounting Studies 20: 1373-1406.
[22] Callen, J.L., S.W. Robb, and D. Segal. 2008. Revenue Manipulation and Restatements by Loss Firms. Auditing: A Journal of Practice & Theory 27: 1-29.
[23] Cohen, J.R., L.L. Holder-Webb, L. Nath, and D. Wood. 2012. Corporate Reporting of Nonfinancial Leading Indicators of Economic Performance and Sustainability. Accounting Horizons

26 (1): 65-90.
[24] Cressey, D. R. (1953). Other People's Money. Montclair, NJ: Patterson Smith, pp.1-300.
[25] Dechow, P.M, R.G. Sloan, and A.P. Sweeney. 1996. Causes and consequences of earnings manipulation: An analysis of firms subject to enforcement actions by the SEC. Contemporary Accounting Research, Vol 13, no. 1, pp. 1-36.
[26] Dechow, P.M. and A. Sweeney. 1995. Detecting Earnings Management. The Accounting Review 70: 193-225.
[27] Dechow, P.M., W. Ge, C.R. Larson, and R.G. Sloan. 2011. Predicting Material Accounting Misstatements. Contemporary Accounting Research 28: 17-82.
[28] Elda du Toit (2208) Characteristics of companies with a higher risk of financial statement fraud: A survey of the literature. South African Journal of Accounting Research, Volume 22, 2008- issue 1,pages 19-44
[29] Farber, D. 2005. Restoring Trust After Fraud: Does Corporate Governance Matter? The Accounting Review 80: 539-561.
[30] Feroz, E.H., K. Park, and V.S. Pastena. 1991. The Financial and Market Effects of the SEC's Accounting and Auditing Enforcement Releases. Journal of Accounting Research 29: 107-142.
[31] Francis, J., D. Philbrick, and K. Schipper. 1994. Shareholder Litigation and corporate Disclosures. Journal of Accounting Research 32 (Autumn): 137-164.
[32] Green B.P. and Choi J.H.,(1997). Assessing the risk of management fraud through neural network technology, Auditing: A journal of Practice and Theory, Vol. 16(1), 14-28
[33] Gul F.A., Lynn S.G., Tsui J.S.L. (2002), Audit quality management ownership and the informativeness of accounting earnings, Journal of Accounting, Auditing and Finance, Vol. 17, No.1, pp. 25-49.
[34] Gupta P.K.,Gupta Sanjeev, (2015),'Corporate frauds in India – perceptions and emerging issues', Journal of Financial Crime, Vol 22, Iss 1.pp. 79-133.
[35] Hogan, C.E., Z. Rezaee, R.A. Riley, Jr., and U.K. Velury. 2008. Financial Statement Fraud: Insights from the Academic Literature. Auditing: A Journal of Practice & Theory 27 (2): 231-252.
[36] ICSI (2007), The Institute of Company Secretaries of India, Guidance Note on Corporate Governance Certificate, ICSI, New Delhi.
[37] Jones, J. 1991. Earnings Management during Import Relief Investigations. Journal of Accounting Research 29: 193-228.
[38] Juszczak, P., Adams, N.M., Hand, D.J., Whitrow, C., & Weston, D.J. (2008). Off-the-peg and bespoke classifiers for fraud detectionll, Computational Statistics and Data Analysis, vol. 52 (9): 4521-4532
[39] Kaminski, K.A., and T.S. Wetzel. 2004. Financial Ratios and Fraud: An Exploratory Study using Chaos Theory. Journal of Forensic Accounting V: 147-172.
[40] Kaminski, K.A., T.S. Wetzel, and L. Guan. 2004. Can Financial Ratios Detect Fraudulent Financial Reporting? Managerial Auditing Journal 19 (1): 15-28.
[41] Marquardt, C.A., and C.I. Wiedman. 2004. How Are Earnings Managed? An Examination of Specific Accruals. Contemporary Accounting Research 21: 461-491.
[42] Nieschwietz, Robert J., Joseph J. Schultz, Jr. and Mark F. Zimbelman, Empirical Research on External Auditors' Detection of Financial Statement Fraud. Journal of Accounting Literature Vol. 19, 2000: pp 190-246.
[43] OECD (1999) Principles of corporate governance 1999, OECD
[44] OECD (2004) Principles of corporate governance 2004, OECD
[45] Palmrose, Z-V. 1988. An Analysis of Auditor Litigation and Audit Service Quality. The Accounting Review 63 (January): 55-73.
[46] Public Company Accounting Oversight Board (PCAOB). 2010. Identifying and Assessing Risks of Material Misstatement Accounting Standard No. 2110. Washington, DC: PCAOB
[47] PWC's 2018 Global Economic Crime and Fraud Survey.
[48] Rathinaraj D. (2010). Financial fraud, cyber scams and India – A small survey of popular recent cases, Anna University of Technology, Chennai.
[49] Rezaee, Z. 2005. Causes, Consequences, and Deterrence of Financial Statement Fraud. Critical Perspectives on Accounting 16: 277-298.
[50] Securities and Exchange Commission (SEC). 1999. Revenue Recognition. Staff Accounting Bulletin No. 101. Washington D.C.: Government Printing Office.
[51] Skousen, Christopher J., Charlotte J Wright,(2008) Contemporaneous Risk Factors and The prediction of Financial Statement Fraud, Journal of Forensic Accoutning IX:37-62
[52] Skousen, Christopher J., Kevin R. Sminth, and Charlotte J. Wright (2009). "Detecting and Predicting Financial Staement Fraud: The Effectiveness of the Fraud Triangle and SAS No. 99". SSRN Working Paper Series Feb
[53] Trompeter, G., T. Carpenter, N. Desai, K. Jones, and R. Riley. 2013. A Synthesis of Fraud Related Research. Auditing: A Journal of Practice and Theory 32: 287-321.
[54] Verma Gakhar, D. (2013). Earnings management practices in India: A study of auditor's perception. Journal of Financial Crime, 21(1), 100-110.
[55] Wells, J.T. 1990. Six common myths about fraud. Journal of Accountancy. 169(2):82-88.
[56] Zmijewski, M.E. 1984. Methodological Issues Related to the Estimation of Financial Distress Prediction Models. Journal of Accounting Research 22: 59-82