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**Detecting accounting fraud using
quantitative techniques**

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DETECTING ACCOUNTING FRAUD USING QUANTITATIVE TECHNIQUES

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ABSTRACT

This study deals with the detection of accounting fraud from an economic perspective. It is a topic of great relevance since the accounting information of a company is crucial in the decision-making process of different stakeholders. However, very often accounting frauds occurs and have very negative consequences. This motivates the interest in detecting fraud as soon as possible.

In this article, we propose the use of a set of accounting fraud detection techniques and they are applied to the case of Ricoh India, a company that had an accounting fraud that caused a great scandal in 2015.

The main contribution of the study is the empirical demonstration that it is possible to detect accounting fraud several years before the deception is disclosed to all interested parties. Early detection of the fraud can be of great use to managers, analysts, investors, and supervisors in their desire to avoid the negative consequences of accounting fraud.

Keywords: Accounts manipulation, Accounting fraud, Balance Sheet, Income statement, Ratios, Z Score.

JEL: M41, M42

1. INTRODUCTION

This article deals with the topic of the detection of accounting fraud³ also known as accounts manipulation, earnings management or creative accounting. Many researchers have come up with their own definitions of accounts manipulation. According to Heahly and Wahlen accounts manipulation means “*to alter financial reports to either mislead some stakeholders about the underlying performance of the company or to influence contractual outcomes that depend on reported accounting numbers*”⁴. According to the above definition, it will not be a stretch to consider accounts manipulation a fraudulent and morally corrupt behaviour undertaken by individuals at powerful positions to gain short-term profits in an organization⁵.

Beneish gave a more straightforward definition of the term by simply describing it “*as violation of Generally Accepted Accounting Principles (GAAP) in order to beneficially represent the firm’s financial performance*”^{6 7}. Recognizing accounts manipulation is imperative to protecting the rights of accounting users, however, it has proven to be a daunting task. To combat this issue, many economists and accountants have come up with different models to separate accounts manipulators from non-manipulators. The objective of this research is to recognize early warning indicators in a company’s financials before it becomes too late in order to protect accounting users.

In order to test the usefulness of the techniques proposed we will apply them to Ricoh India. The management of Ricoh India, an Indian subsidiary of the Japanese giant, is said to be implicated in falsifying the accounts of the company. The case was known when they failed to disclose their accounts for two quarters in 2015, although, it’s suspected that the books were being cooked since 2012. According to Krishnan: “*the auditor unearthed attempts of out-of-books adjustments to net sales, expenses, assets and liabilities, thus, converting losses to profits*”⁸. The forensic auditors reported a loss of 11170 million Rupees (nearly 143 million euros) on top of 9980 million Rupees in 2016 after they thoroughly investigated the books. Once, the scandal came into limelight, the Japanese parent company promised a turnaround by investing new capital, but the turnaround did not bear results and since then Ricoh India has filed for bankruptcy. The Bombay Stock Exchange restricted Ricoh to trade publicly from 13 December 2016.

A detailed scrutiny highlighted the strange accounting practices of Ricoh India. The product sales were entered in the books without the delivery of the products and service revenues were recognized without completion of the projects. Delivery of products were done to parties with wrong addresses and cut-out company sales were carried out, where Ricoh purchased its own products at double price from a company, thus making 71 percent of the reported revenues from the “IT services”. Moreover, personal favours were granted to current and ex- employees

³ ZAYAS MARISCAL, L., “Señales de alerta para la detección del fraude en las empresas, *Revista de Contabilidad y Dirección*, Vol. 23, 2016, p. 59-81.

⁴ HEALY/WAHLEN, “A review of the earnings management literature and its implications for standard setting”, *Accounting horizons*, 13(4), 1999, p. 365-383.

⁵ CUGUERÓ-ESCOFET/VILLAESCUSA, “Virtues of integrity and veracity in reporting, data alone is not enough. A case study approach”, *European Accounting and Management Review*, 4(2), 2018, p. 93-110.

⁶ BENEISH, “The detection of earnings manipulation”, *Financial Analysts Journal*, 55(5), 1999, p. 24-36.

⁷ PARRONDO FORT, L., “Earnings Management under IFRS and PGC”, *Revista de Contabilidad y Dirección*, Vol. 16, 2013, p. 161-185.

⁸ KRISHNAN, “Trouble at Ricoh: a lot like Satyam”, *The Hindu Business Line*. February 16. 2018.

from the company's account. This scandal highlighted the consequences of poor corporate governance and the responsibility of board of directors, auditors, and parent companies' control over their subsidiaries⁹.

Even though the auditor was able to uncover illegal accounting practices, the reasons as to why such practice was followed remain elusive. Healy and Wahlen define that accounting manipulations are carried out to mislead stakeholders about the economic performance of the company¹⁰. In few cases, it is done to deceive auditors so that the value of the company's stock remains high. Gowthorpe and Amat¹¹ mention that if directors are involved in insider trading of their company shares, they may withhold information from the market, in order to benefit from the inside information. There are other reasons mentioned in the literature ranging from taxation to revenue inflations that explain this multi-faceted phenomenon of account manipulations.

The next section focuses on several techniques suggested for the early detection of accounts manipulations.

2. METHODS TO DETECT ACCOUNTS MANIPULATIONS

2.1. Differences between profit and cash

One of the best red flag of accounts manipulation is the difference between earnings and cash, using information from the cash flow statement. In general, earnings and cash should have a similar evolution. When differences appear, it is because of the accruals which are contained in the earnings of a company. These non-cash parts are revenues or expenses that do not have impact in cash. Examples of accruals are invoices owed by customers that have not been paid or increase in inventories that have not been sold. An increase in the difference between earnings and cash, means an increase in accruals. When the difference is positive, because profits are higher than the cash generated, it can be a signal that the company has inflated the earnings, for example to show a better economic image. If the difference is negative, because the profits are lower than the cash generated, it can be a signal that the company has reduced the earnings, for example to pay less taxes. These differences can signal a higher probability of accounts manipulation because earnings and expenses are easier to manipulate than cash movements¹².

Net Profit before Tax
- Net Cash from Operating Activities
Difference between profit and cash

2.2. Ratio analysis

⁹ GOYAL/DHAMIJA, "Corporate governance failure at Ricoh India: rebuilding lost trust", *Emerald Emerging Markets Case Studies*, 8 (4), 2018, p. 1-20.

¹⁰ HEALY/WAHLEN, "A review of the earnings management literature and its implications for standard setting", *Accounting horizons*, 13(4), 1999, p. 365-383.

¹¹ GOWTHORPE/AMAT, "Creative Accounting: Some Ethical Issues of Macro- and Micro-Manipulation", *Journal of Business Ethics*, 57, 2005, p. 55-64.

¹² VLADU/AMAT/CUZDRIOREAN, "Truthfulness in accounting: How to discriminate accounting manipulators from non-manipulators", *Journal of business ethics*, 140 (4), 2017, p. 633-648.

Sloan Ratio: Sloan stipulated that the higher amount of accruals a company has, the lower would be the level of performance because the accruals determine the quality of earnings of a company¹³. Moreover, accruals are more susceptible to subjective judgements and assumptions that provide a huge margin for account manipulation. The Sloan ratio is given as the difference of Net profit and the cash generated by operations divided by total assets:

$$\text{Sloan Ratio} = \frac{(\text{Net Profit before Tax} - \text{Net Cash from Operating Activities})}{\text{Total Assets}}$$

According to Sloan, a value higher than 10% reflects that there is a huge difference between the reported profit and the cash generated, and this can be suspicious.

Liquidity Ratio: Insufficient solvency¹⁴ has always been associated with the likelihood of fraud. Companies that have a high amount of short-term debt have been observed to give in to temptations of manipulating accounts because their short-term solvency issues threaten their company's value and may lead them to bankruptcy¹⁵. Hence, evaluating liquidity ratio (Current assets/Current liabilities) is a simple yet effective measure in identifying fraud. In general, when this ratio is much lower than 1, and gets lower along the years, can be a signal of liquidity problems.

Debt Ratio: This ratio is calculated dividing total debt by equity (Total Debt / Equity). Excessive debt always signals a red flag in company's accounts. Excessive debt indicates multiple issues. For example, is a signal that the company is unable to sustain its operations with its own earnings and needs continued refinancing through loans. The way in which the debt is being used in the company (either as an investment or buy-outs, for example) determine its financial health. If the company is highly leveraged, it might present a motivation for managers to perform accounts manipulation and report profit of the company.

2.3. Benford's Law of anomalous numbers

The law of "*anomalous numbers*" is used by auditors and accountants to determine a chance of account manipulation. Benford analysis¹⁶ can reveal bizarre patterns in the accounts in case the numbers have been "cooked". According to this law, in a naturally occurring collection of the numbers, the leading digit should likely be small, and with increase in the value of the digits the probability of them occurring naturally in the dataset decreases logarithmically (base 10). Nigrini explained the use of Benford's law in accounting¹⁷. The law can be applied to a small dataset with 50 datapoints, however, the larger the data set the better. Durtschi et al. mention that accounting data should conform to Benford's distribution because the numbers are naturally generated and transactions result from combining numbers¹⁸. This law helps in identifying the initial markers of manipulations as assigned numbers tend to follow a uniform

¹³ SLOAN, "Do stock prices fully reflect information in accruals and cash flows about future earnings?", *Accounting review*, 1996, p. 289-315.

¹⁴ ROS/RUIZ/RUSIÑOL/VALERIANO, (2019), "The Risk of Insolvency and the Audit Report", *European Accounting and Management Review*, 6(1), p. 40-52.

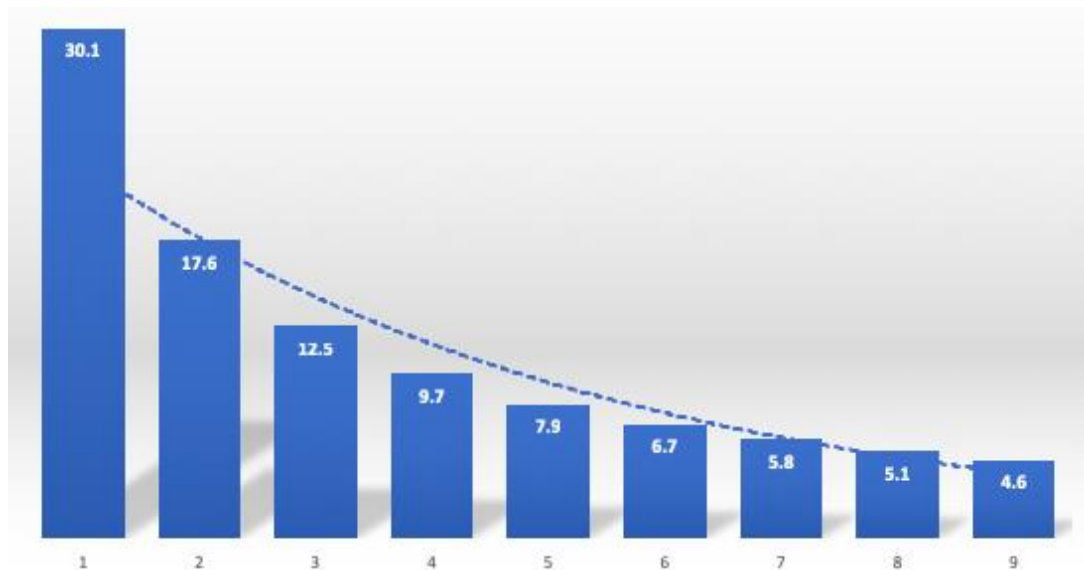
¹⁵ AMAT, *Detecting Accounting Fraud Before It's Too Late*, John Wiley & Sons, 2019.

¹⁶ BENFORD, "The Law of Anomalous Numbers", *Proceedings of the American Philosophical Society*, Vol. 78, No. 4, 1938, p. 551-572.

¹⁷ NIGRINI, "*Forensic analytics: Methods and techniques for forensic accounting investigations*", John Wiley & Sons, 2011.

¹⁸ DURTSCHI/HILLISON/PACINI, "The effective use of Bedford's law to assist in detecting fraud in accounting data", *Journal of forensic accounting*, 5(1), 2004, p. 17-34.

distribution instead of Benford’s distribution. The below figure shows the logarithmic pattern of naturally occurring datasets. The probability of 1 in a dataset is 30.1% while a 9 appears the least and only with a probability of 4.6%. This is essential to observe because in a manipulated dataset the numbers occur uniformly rather than logarithmically.



Source: Benford (1938)

Figure 1. Benford’s Distribution.

2.4. Statistical analysis

Ratio analysis has long been relied upon for predicting bankruptcy and manipulations. However, Altman argued that although the ratios that measure profitability, liquidity and solvency are the most significant, it is necessary to know which ratios are more relevant¹⁹.

To solve this problem, techniques such as Multiple Discriminant Analysis are used to divide a set of companies into two subsets, for example, those that manipulate accounts and those that do not. Following are some of the most relevant formulas:

Altman Z Score: Altman proposed the Z Score formula for predicting bankruptcy for publicly traded companies²⁰. The Altman model could predict the “possibility” of a company going into bankruptcy in the next two years. However, the model did not fit for the private companies, hence, in 2000 a revised model was introduced by Altman, that replaced the market value of equity in 1968 model to book value of equity²¹. This model consists of five crucial ratios that are used as discriminants to identify potential bankruptcy. These ratios can also signal underlying issues in a company’s accounts that can lead to malpractices in accounting. The ratios used in this model are:

¹⁹ ALTMAN, “Financial ratios, discriminant analysis and the prediction of corporate bankruptcy”, *The journal of finance*, 23(4), 1968, p. 589-609.

²⁰ ALTMAN, “Financial ratios, discriminant analysis and the prediction of corporate bankruptcy”, *The journal of finance*, 23(4), p. 589-609.

²¹ ALTMAN, “Predicting financial distress of companies: revisiting the Z-score and ZETA models”, *Stern School of Business, New York University*, 2000, p.9-12.

- a) **(Current Assets – Current Liabilities)/Total Assets (X1)**: This ratio measures the level of liquidity in a company’s balance sheet. Since, current liabilities represent the debt paid in the nearest future, a low or negative ratio would signify a company facing solvency problems.
- b) **Retained Earnings/Total Assets (X2)**: This ratio helps in determining the ability of a company to support its investments and operations in future. Old companies should in theory have higher retained earnings and hence, their chance of going bankrupt in the near future is lower than their younger counterparts that have a low level of cumulative earnings. If the ratio is too low, then it can be deduced that company relies on external debt to fund its operations and therefore is highly leveraged, which can be problematic as it increases debt obligations and can result in bankruptcy or an opportunity for accounts manipulation.
- c) **Earnings before interest and taxes / Total assets (X3)**: The return on total assets determines the “real” operational return on total assets, with no consideration of tax effects. This ratio helps in determining the “true productivity” of a company as well as its earning capacity.
- d) **Book value of equity / Total liabilities (X4)**: This ratio indicates the percentage of liabilities funded by the shareholders. If the level of equity is too low, then the company might need more debt to fund its operations. In general, companies with higher level of equity are at a low risk of insolvency.
- e) **Sales / Total Assets (X5)**: This ratio stipulates the efficiency of the company to manage its assets. This ratio can also be used to evaluate competition among similar companies. If this turnover is high, it means that a company produces higher revenue with less investment.

The final Z Score for private companies is given by the formula:

$$Z = 0.717 \times (X_1) + 0.847 \times (X_2) + 3.107 \times (X_3) + 0.420 \times (X_4) + 0.998 \times (X_5)$$

After substituting the values of the ratios and adding the coefficients a Z Score can be obtained which can be interpreted as follows:

- > 2.9: Bankruptcy not likely
- 1.23 - 2.9: Grey Area
- <1.23: Bankruptcy very likely

Altman’s Z Score was met with trepidations and has been criticised. Hillegeist et al.²² and Gharghori et al.²³ stipulate that Altman Z-score model includes numerous measures of accounting variables which drawn from the financial and income statements. However, it does

²² HILLEGEIST/KEATING/CRAM/LUNDSTEDT, “Assessing the probability of bankruptcy”, *Review of accounting studies*, 9 (1), 2004, p. 5-34.

²³ GHARGHORI/CHAN/FAFF, “Investigating the performance of alternative default-risk models: Option-based versus accounting-based approaches”, *Australian Journal of Management*, 31(2), 2006, p. 207-234.

not indicate anything about the firm's future. Despite these criticisms, some authors suggest that the model has a predictive power of 90% to determine bankruptcy in the next year²⁴.

Beneish M Score: Beneish introduced a statistical model that could predict the possibility of account manipulation in company's accounts²⁵. According to Beneish: "*The evidence indicates that the probability of manipulation increases with: (i) unusual increases in receivables, (ii) deteriorating gross margins, (iii) decreasing asset quality, (iv) sales growth, and (v) increasing accruals.*"²⁶. There are eight variables in the model. Seven of the variables are ratios that compare changes from the previous year to the reported year, to capture any changes resulting from the manipulation. These ratios are:

- a. **Receivables Index (DSRI):** This ratio shows the change in account receivables from the reported year (t) to the corresponding previous year (t-1). If there is a high increase in the amount of receivables of a company, this can indicate the changes in credit policy of the company and can predict the likelihood of inflated sales.
- b. **Gross Margin Index (GMI):** This is the ratio of Gross margin (Net sales – Cost of goods sold) from the previous year (t-1) and the reported year (t). Harrington states that a GMI of 1.041 or lower indicates no manipulation, but a GMI index of 1.193 or higher indicates manipulations²⁷. A deteriorating financial health of a company can prompt the managers to artificially inflate earnings.
- c. **Asset Quality Index (AQI):** Asset quality is the ratio of non-current assets (other than PPE, property, plant and equipment) to total assets in a given year. Hence, AQI captures the change in asset quality in the reported year in comparison to previous year. An increase in AQI indicates that additional expenses are being capitalized to avoid losses²⁸.
- d. **Sales Growth Index (SGI):** This ratio denotes the increase in sales in the reported year as compared to previous year sales. Intuitively, a disproportionate increase in sales in one year could indicate manipulations.
- e. **Depreciation Index (DPI):** DPI shows the change in depreciation of PPE in previous year (t-1) as compared to year (t). Since, depreciation is "not" physical cash inflow or outflow, manipulators tend to change the policies by which they calculate depreciation of their assets in the accounts to adjust earnings.
- f. **Sales General and Administrative Expenses Index (SGAI):** It is calculated as ratio of SG&A to sales in year t to the corresponding measure in the year (t-1). If these

²⁴ FITO/PLANA-ERTA/LLOBET, "Usefulness of Z scoring models in the early detection of financial problems in bankrupt Spanish companies", *Intangible Capital*, 14(1), 2018, p. 162-170.

²⁵ BENEISH, "The detection of earnings manipulation". *Financial Analysts Journal*, 55(5), 1999, p.24-36.

²⁶ AMAT, *Detecting Accounting Fraud Before It's Too Late*. John Wiley & Sons, 2019.

²⁷ HARRINGTON, "Analysis ratios for detecting financial statement fraud", *Fraud Magazine*, March/April, 2005.

²⁸ HARRINGTON, "Analysis ratios for detecting financial statement fraud", *Fraud Magazine*, March/April, 2005.

expenses increase disproportionately, it might be a signal of manipulation because higher expenses may predict worse future prospects²⁹.

- g. **Total Accruals to Total Assets (TATA):** This ratio measures the change in working capital (other than depreciation) with respect to total assets. Accruals refer to accrued earnings that are still unpaid and therefore can be included as assets. However, the higher number of accruals can indicate the probability of manipulation because the accruals are still not converted to real cash and thus, are easier to manipulate than actual cash transactions.
- h. **Leverage Index (LVGI):** LVGI is the ratio of total debt to assets in current year (t) to previous year (t-1). If the LVGI is higher for the year t, it indicates that the company heavily relies on debt to sponsor its operations and the probability of it being a manipulator increases in order to showcase a healthy growth.

The Beneish M Score is given by the formula:

$$\text{M Score} = -4.84 + 0.92 \times \text{DSRI} + 0.528 \times \text{GMI} + 0.404 \times \text{AQI} + 0.892 \times \text{SGI} + 0.115 \times \text{DPI} - 0.172 \times \text{SGAI} + 4.679 \times \text{TATA} - 0.327 \times \text{LVGI}$$

M Score is less than -2.22: Low probability that the company is a manipulator.

M Score is greater than -2.22: High probability that the company is a manipulator.

Beneish M Score has an accuracy rate of 76%, in identifying manipulators³⁰.

Vladu, Amat and Cuzdiorean Z Score: This is a Z index³¹ useful to detect companies that have committed accounting fraud. The formula uses four ratios.

- a) **Index of customers to sales (R1):** Calculated as the ratio of increase in account receivables with respect to sales from the previous year to the current year. If the increase in receivables is too high it can be a sign of manipulation.
- b) **Index of inventory to cost of sales (R2):** If the ratio of inventory level with respect to cost of goods sold increases from the previous year to the current year, manipulation could be a possibility.
- c) **Index of depreciation compared to PPE (R3):** Any abrupt changes in the policies of the company by which they calculate depreciation can indicate possible manipulation.
- d) **Index of debt to assets (R4):** Intuitively, if the ratio of debts with respect to the total assets increase asymmetrically from previous years to current year, we can deduce the possibility of manipulations. Debt has been a huge factor in determining the likelihood of bankruptcy which has been found as a strong motivator for accounts manipulation.

$$\text{Z score} : -4.5 + (0.03 \times \text{R1}) + (0.15 \times \text{R2}) - (0.17 \times \text{R3}) + (4.23 \times \text{R4})$$

²⁹ LEV/THIAGARAJAN, "Fundamental information analysis", *Journal of Accounting research*, 31(2), 1993, p. 190-215.

³⁰ BENEISH, "The detection of earnings manipulation", *Financial Analysts Journal*, 55(5), 1999, p. 24-36.

³¹ VLADU/AMAT/CUZDRIOREAN, "Truthfulness in accounting: How to discriminate accounting manipulators from non-manipulators", *Journal of business ethics*, 140 (4), 2017, p.633-648.

$Z > 0.20$:	High probability that the company is a manipulator.
$-0.24 < Z < 0.20$:	Grey Zone
$Z < - 0.24$:	Low probability that the company is a manipulator.

The accuracy of this model in identifying manipulations is between 72% and 77%³².

Fraud F Score: Dechow et al³³ came up with another model derived on the same method by Beneish. This model is based in a regression to calculate the probability of fraud and was calculated with a sample with more than 2000 companies investigated by SEC (Securities and Exchange Commission). The model is the following:

- a. **Change in net operating assets scaled by average total assets (Rsst_accr):** This term defines the amount of accruals, and is a complicated calculation, however, without any use of regression. Accruals have always been considered as an important discriminant in determining manipulation because they are easier to expand than real cash.
- b. **Change in account receivables divided by total assets (deltaAR):** An increase in the ratio is an indicator of manipulation.
- c. **Change in inventory divided by total assets (deltaINV):** An increase in the ratio is an indicator of manipulation.
- d. **Percentage of soft assets (%SFT):** Soft assets are defined as total assets minus the cash and the residual values of long-term tangible assets such as PPE and investment property etc. Barton et al, stipulate that more creative accounting techniques could be applied to net operating assets, and hence, companies that have more percentage of soft assets will have more opportunities to manipulate accounts³⁴.
- e. **Changes in cash revenue (deltaCashSales):** This ratio defines the changes in cash revenue from previous year to this year. The cash revenue is calculated as a difference of sales and account receivables.
- f. **Change in the rate of Return on Assets (delta ROA):** ROA (Earnings before interest and taxes divided by Assets) reflects the measure of efficiency of the use of assets. ROA helps in determining the return the company should expect on their capital expenditure. In many cases, ROA is also associated with the variable remuneration of managers, thus, a low ROA change from 1 year to another may probe the managers to inflate numbers in order to increase ROA for selfish purposes. Therefore, the change in the rate of return of assets should be negatively associated with the possibility of manipulation.

³² VLADU/AMAT/CUZDRIOREAN, "Truthfulness in accounting: How to discriminate accounting manipulators from non-manipulators", *Journal of business ethics*, 140(4), 2017, p. 633-648.

³³ DECHOW/GE/LARSON/SLOAN, "Predicting material accounting misstatements", *Contemporary accounting research*, 28(1), 2011, p. 17-82.

³⁴ BARTON/SIMKO, "The balance sheet as an earnings management constraint", *The accounting review*, 77(s-1), 2002, p.1-27.

- g. **Issue of long term-debt or common stock (Issue):** The binary variable that is 1 if the company issued long-term debt or common stock in the year t (the year of manipulation) and 0 otherwise.

$$\text{logit} = -7.893 + 0.790 \times \text{RSST_accr} + 2.518 \times \text{deltaAR} + 1.191 \times \text{deltaINV} + 1.979 \times \% \text{SFT} + 0.171 \times \text{deltaCashSales} - 0.932 \times \text{deltaROA} + 1.029 \times \text{Issue}$$

$$\text{Prob(FFR)} = e^{\text{logit}} / (1 + e^{\text{logit}})$$

$$\text{F Score: Prob (FFR)} / 0.0037$$

F Score > 2.45:	Very high probability of accounting fraud
F Score > 1.85:	High risk of accounting fraud
F Score >= 1:	Risk of accounting fraud above normal level
F Score < 1:	The risk of accounting fraud is normal or below normal

3. THE CASE OF RICOH INDIA

The methodology used in this paper is the case research based on Ricoh's account manipulation, one of the biggest accounting scandals in recent history.

3.1. History

Founded by Riken Zaibatsu on February 6, 1936, Ricoh Company Ltd, is a Japanese multinational imaging and electronics company currently based in Chuo, Tokyo. Ricoh then, in collaboration with RPG Industries opened RPG Ricoh Ltd in India on 22nd October 1993. Ricoh India specializes in office imaging equipment, production print solutions, document management systems and IT services. Right before the Ricoh India accounting scandal, Ricoh made into World's most "ethical" companies list by Ethisphere for fifth year in a row. At the time of the scandal Manoj Kumar was serving as the CEO of Ricoh India.

Figure 2 presents the list of competitors of Ricoh India.

Competition					
Name	Last Price	Market Cap. (Rs. cr.)	Sales Turnover	Net Profit	Total Assets
CMC	2,032.25	6,157.72	1,288.46	197.78	1,191.06
Redington	97.50	3,793.54	16,851.21	152.14	2,434.49
HCL Info	16.40	539.90	2,950.30	-631.57	1,330.08
Airan	30.85	385.69	44.13	5.86	88.49
TVS Electronics	195.55	363.97	2,756.84	7.44	86.98
D-Link India	94.05	333.92	699.63	23.55	199.30
Cerebra Int	26.60	322.36	174.38	12.62	220.77
Smartlink Net	86.80	147.13	18.53	-27.72	250.25
Compuage Info	14.40	93.57	4,514.83	22.58	654.96
MRO-TEK	32.30	60.35	26.92	-9.86	33.13
Moser Baer	1.20	26.61	546.60	-1,113.95	-2,138.65
Zenith Computer	2.55	3.95	0.59	-4.04	15.13
EuroMult	0.70	1.67	11.18	-17.19	-221.52
Ricoh India	193.45	769.32	680.59	-894.10	448.87

Figure 2. List of competitors in 2018. Source: moneycontrol.com

3.2. The scandal

Ricoh India came into limelight after it failed to report the 2nd and 3rd quarter financial results of the year 2015 to Bombay Stock Exchange. The company appointed PwC for a forensic review of the accounts which reported a hint of accounts manipulation. In the conclusions of the review, PwC said that Ricoh India's financial statements for April 1 to September 30, 2015 *"did not reflect a true and fair view of the state of affairs of the company... As per the investigation, it appears that the accounts have been falsified and the company's accounting principles and standards have been violated"*³⁵. SEBI (Securities and Exchange Board of India) took action and the Bombay Stock Exchange (BSE) suspended the trading of company's shares because of non-compliance with SEBI listing norms. Finally, in May 2016, the company was able to report its financials and reported a huge loss (approx. 11230 million Indian Rupee).

During the forensic audit, many malpractices were uncovered, for example, in March 2014, the value of debt was nearly 3570 million Rupees (around 45 million Euros) but by March 2016 the debt increased to 23450 million Rupees (around 300 million euros), without any big investments. Revenues and receivables were inflated to reflect a better image of the company. Fictitious sales and bad debts were created, moreover invoices were created for addresses that did not exist. Profits and inventories were inflated to a huge extent.

Ricoh Japan tried to revive its Indian subsidiary by declaring to invest 11230 million Rupees (around 144 million Euros) in it. Ricoh Japan was already facing increase in losses from 4% to 12% from 2015 to 2016, but with the news of manipulation in media, the stock price of Ricoh Japan fell by 25% from \$10.74 to \$8.

Timeline of fraud

Ricoh India's scandal is still being unravelled by SEBI (Securities and Exchange Board of India). The investigation has not been closed and an interim order dated 12th February, 2018 has been ordered to complete the forensic audit of Ricoh India. No definite name has yet been held responsible by the officials in this case, despite the suspicious resignation of more than three high level officials of Ricoh India.

As reported by CNBC, the whole issue started July 2015 with the change of auditors. Previous auditors Sahni Natarajan & Bahl were replaced by BSR and Co. It was considered as normal business but issues arose when Ricoh failed to report the earnings for the next two quarters. For few months, the company's management reassured the shareholders that the delay was normal and there was no foul play involved. But once the company was moved to Z category by the Bombay Stock Exchange to warn the public and shareholders of the potential malpractices involved, the situations spiralled out of control for Ricoh's management team. Once, the suspicions of accounts manipulation emerged, the CEO & MD, Manoj Kumar, CFO Arvind Singhal and COO Anil Saini were sent away on paid leave, however, CEO & MD Manoj Kumar insisted that it is normal for management to be released in cases of investigations so as not to interrupt it. But this caused a huge blow to the shares of Ricoh India, Ricoh's shares went down a 67%.

³⁵ NDTV: "Accounting Fraud: Ricoh Sacks Two, Accepts CEO's Resignation", November 27, 2016. <https://www.ndtv.com/business/accounting-fraud-ricoh-sacks-two-accepts-ceos-resignation-1630883>

In April 2016, AT Rajan is appointed as the new CEO. During this time, the regulators suspect that the fraud may have been committed since 2012 and not 2015 as the management assures. By other hand, Ricoh Japan filed a complaint against the Indian subsidiary and its officials.

3.3. Detection of the manipulation

In this part we analyse the accounts of the years 2009 to 2018 included in the Appendix.

3.3.1. Differences between profit and cash

If we calculate the differences between profit and cash using Ricoh accounts, we obtain the following numbers (figure 3).

Difference	+ 860,9	+504,38	+1109,00	-272,94	-88,97	-				
	Mar '18	Mar '17	Mar '16	Mar '15	Mar '14	Mar '13	Mar '12	Mar '11	Mar '10	Mar '09
Net Profit Before Tax	-893.15	-333.2	-1109.09	50.49	30.12	0.39	-2.47	25.43	27.8	19.6
Net Cash From Operating Activities	-32.25	171.18	0	-222.45	-58.85	-96.67	-63.02	-9.44	35.39	-9.26
97,06	-60,55	-34,87	+7,59	-28,86						

Figure 3. Ricoh India's differences between profit and cash from 2009 to 2018

Using the data included in figure 3 we can observe that from 2011 to 2015 we have increasing negative differences between earnings and cash. This is a clear red flag that can be observed several years before 2015, when the scandal was on the press.

3.3.2. Ratio analysis

Sloan Ratio

According to the data shown in figure 4, the Sloan Ratio of Ricoh has consistently remained higher than 10% in 2009, and from 2011 to 2015, the year of manipulation. This shows a huge impact of accruals.

	Mar '18	Mar '17	Mar '16	Mar '15	Mar '14	Mar '13	Mar '12	Mar '11	Mar '10	Mar '09
Net Profit Before Tax	-893.15	-333.2	-1109.09	50.49	30.12	0.39	-2.47	25.43	27.8	19.6
Net Cash From Operating Activities	-32.25	171.18	0	-222.45	-58.85	-96.67	-63.02	-9.44	35.39	-9.26
Total Assets	1,426.24	1,943.75	2,132.74	1,294.88	860.28	744.63	378.05	253.93	214.67	181.56
Sloan Ratio	-0.604	-0.259	-0.520	0.211	0.103	0.130	0.160	0.137	-0.035	0.159
Net Income Increase	168.05	-69.96	-2296.65	67.63	7623.08	-115.79	-109.71	-8.53	41.84	
Net Cash From Operating Activities	-118.84	Unidentified	-100.00	277.99	-39.12	53.40	567.58	-126.67	-482.18	

Note: Sloan Ratio = (Net Profit before Tax – Net Cash from Operating Activities) / Total Assets

Figure 4. Ricoh India's Sloan Ratio from 2009 to 2018

If we specifically look at March 2014, a year before the reported manipulation, the net income increases 7623% but the cash by operations change is -39%. In almost all years, the changes are disproportionate, thus indicating that accounts have been tampered with from quite long.

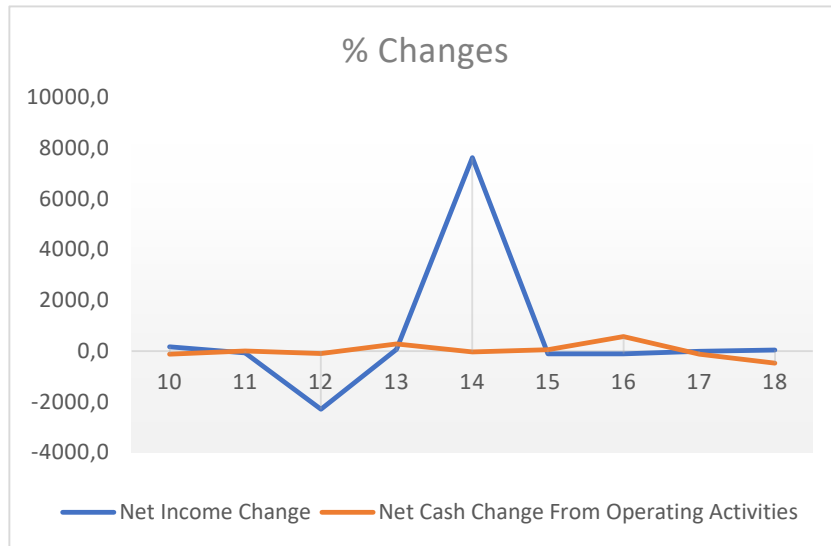


Figure 5. Ricoh India's percentage of change in Net Income and Cash from Operations

As we have pointed out, when there are important differences between earnings and cash it is a clear red flag of accounts manipulation.

Liquidity Ratio

Ricoh's liquidity never dip down below 1. Considering this we can assume that in all the years examined the company was not facing any issues with fulfilling its short-term liabilities (see figure 6).

	Mar '18	Mar '17	Mar '16	Mar '15	Mar '14	Mar '13	Mar '12	Mar '11	Mar '10	Mar '09
Liquidity	1.41	1.82	2.80	2.90	2.17	1.91	2.44	1.95	1.90	2.04

Note: Liquidity Ratio = Current assets – Current liabilities

Figure 6. Ricoh India's Liquidity Ratio from 2009 to 2018

Debt Ratio

Since 2013 we can see a clear increase in the debt ratio. The level of debt increased a lot, two years before the manipulation. In this case, we can conclude that the debt ratio was a good red flag from 2013 to 2015.

	Mar '18	Mar '17	Mar '16	Mar '15	Mar '14	Mar '13	Mar '12	Mar '11	Mar '10	Mar '09
Debt Ratio	1.73	1.08	1.45	0.87	0.84	0.84	0.67	0.48	0.46	0.46

Note: Debt Ratio = Total debt / Equity

Figure 7. Ricoh India's Debt Ratio from 2009 to 2018

A graphical representation of the debt ratio compared with some competitors clearly indicates the rising level of the debt in Ricoh (see figure 8).

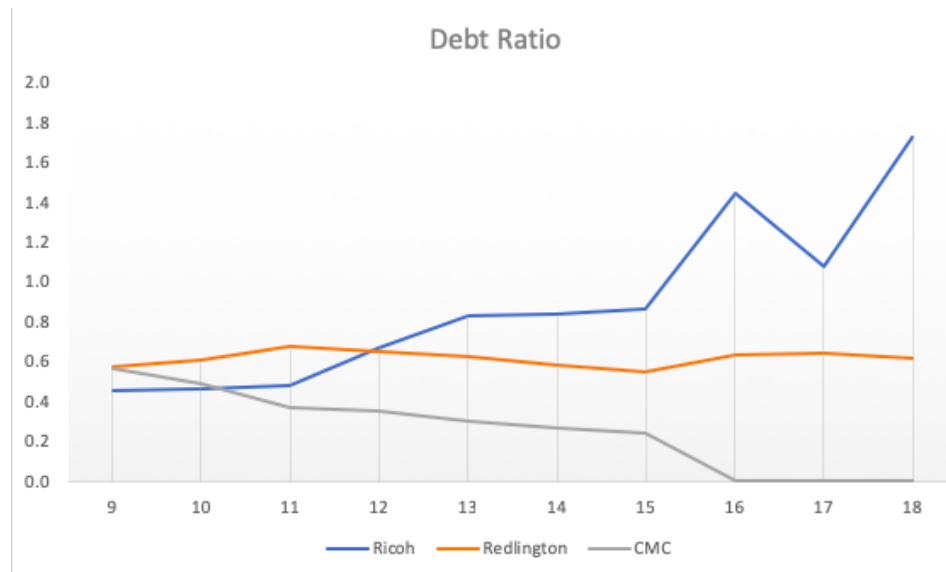


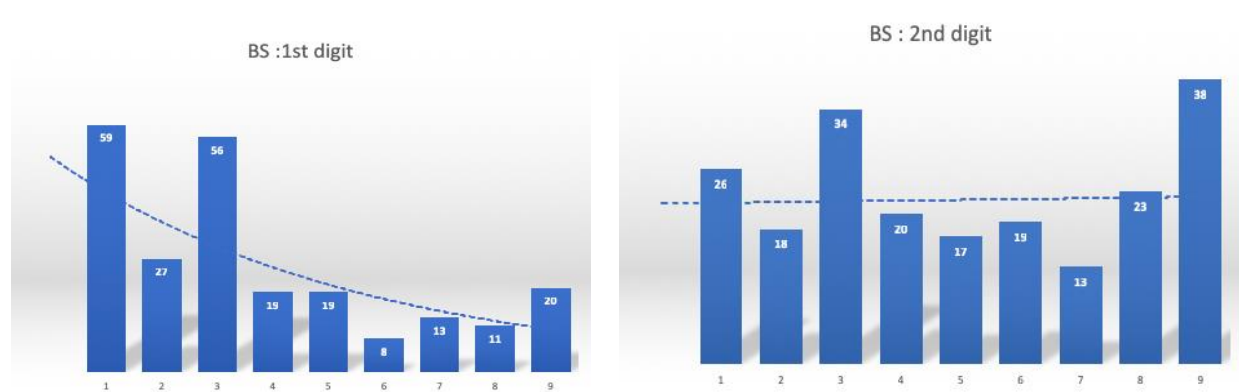
Figure 8. Debt Ratio graphical representation of Ricoh India and main competitors (Redington and CMC)

3.3.3. Benford's Law of anomalous numbers

If we apply the Benford's Law to the accounts of Ricoh (from 2009 to 2015) we obtain the following:

Balance Sheet 1st and 2nd Digit Distribution:

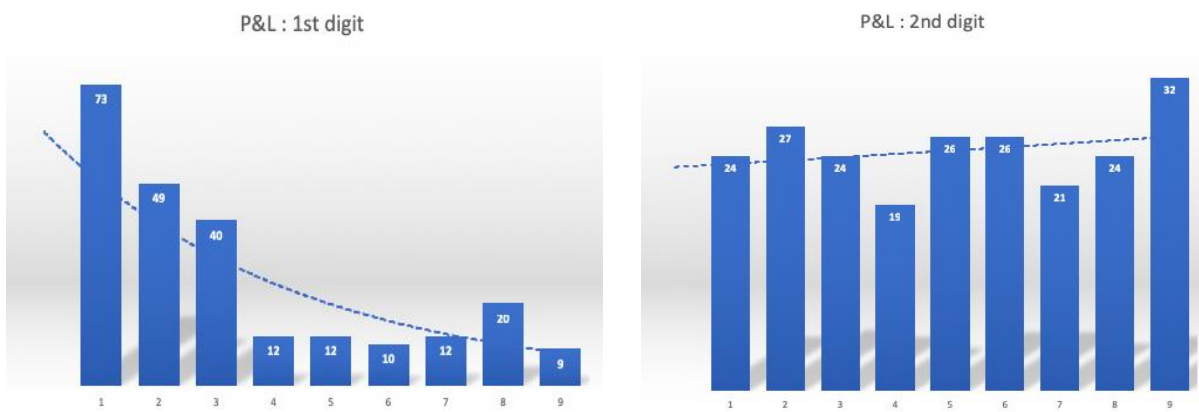
The first digits do show some resemblance to the Benford's Law curve, however, number 3 occurs too many times than its expected natural frequency in a random group. The 2nd digits are more uniformly distributed, specifically number 9 which should occur the least number of times, however, occurs the most. The distribution of the 2nd digits could indicate fabricated numbers in the balance sheet.



Figures 9 and 10. Balance sheet, 1st and 2nd digit distribution for Ricoh India (from 2009 to 2015)

Income Statement 1st and 2nd Digit Distribution:

The first digits till number 3 show correct pattern, however, since number 4 the digits become more uniformly distributed. Number 9 occurs the most time as second digit in the P&L statement, indicating false numbers and calculations.



Figures 11 and 12. Income statement, 1st and 2nd digit distribution for Ricoh India (from 2009 to 2015)

As a conclusion, based on the distribution of the digits, in this case we cannot specifically deduce the use of faulty practices.

3.3.4. Statistical methods

Altman Z Score

The Altman Z Score since year 2010 to 2015 (the year of manipulation) remains in the grey area and never once crosses into the safe zone (figure 13). In this case we do not find a red flag, possibly this is a consequence of the manipulation produced.

	2018	2017	2016	2015	2014	2013	2012	2011	2010	2009
Working Capital / Total Assets	0.28	0.44	0.62	0.62	0.49	0.45	0.53	0.46	0.41	0.48
Retained Earnings / Total Assets	-1.39	-0.27	-0.99	0.12	0.14	0.11	0.22	0.43	0.43	0.39
Earnings before interest and tax / Total Assets	-0.57	-0.08	-0.45	0.12	0.09	0.03	0.03	0.12	0.15	0.15
Book value of equity / Total Liabilities	-0.42	-0.07	-0.31	0.15	0.19	0.20	0.49	1.08	1.16	1.17
Sales / Total Assets	0.48	0.63	0.47	1.26	1.22	0.85	1.14	1.17	1.19	1.33
Z Score	-2.43	0.42	-1.44	2.25	2.05	1.44	2.00	2.67	2.80	2.95
	> 2.9 Not Likely			1.23 - 2.9 Grey Area				<1.23 Very Likely		

Figure 13. Ricoh India's Altman Z Score from 2009 to 2018

Beneish M Score

The Beneish M Score (see figure 14) is more indicative of manipulations than the Altman Z score. This Score shows really interesting insights in the accounts of Ricoh. M score establishes that the company has been manipulating accounts from 2009 itself and not just 2012 or 13.

	18-17	17-16	16-15	15-14	14-13	13-12	12-11	11-10	10-09
DSRI	1.15	0.81	2.58	1.14	0.69	1.52	0.97	1.07	1.11
GMI	1.65	0.30	2.96	1.02	0.74	1.81	1.05	1.44	0.76
SGI	0.56	1.22	0.61	1.56	1.66	1.47	1.45	1.16	1.06
SGAI	7.88	0.01	0.00	0.00	0.00	0.00	0.00	0.00	1.06
AQI	0.84	1.09	1.90	0.89	0.66	1.29	0.80	0.98	1.26
DPI	0.78	0.94	1.25	0.75	1.02	0.88	1.14	0.99	1.04
LVGI	1.61	0.75	1.66	1.04	1.00	1.24	0.00	0.00	0.00
TATA	0.27	0.43	0.61	0.61	0.47	0.44	0.51	0.44	0.40
M Score	-2.60	-0.54	2.88	1.08	-0.07	1.09	0.76	0.52	-0.15
	M-Score < -2.22 Unlikely to be a Manipulator.					M-Score > -2.22 Likely to be a Manipulator.			

Figure 14. Ricoh India's Beneish M Score from 2009 to 2018

Vladu, Amat and Cuzdriorean Z Score

The Vladu, Amat and Cuzdriorean Z score is also indicative of high probability of irregularities in the accounts of 2013 (see figure 15). According to media³⁶ the authorities doubt that the manipulation could have started in 2012 or 2013. In 2013 we can observe a big increase in receivables, inventories and debt; and this are red flags.

	18-17	17-16	16-15	15-14	14-13	13-12	12-11	11-10	10-09
R1	1.15	0.81	2.58	1.14	0.69	1.52	0.97	1.07	1.11
R2	0.98	0.70	3.40	0.60	0.87	1.18	0.98	1.19	0.72
R3	1.39	1.08	0.75	1.44	0.97	1.16	0.86	1.01	0.96
R4	1.29	1.53	1.05	0.78	0.86	1.34	0.77	1.04	1.01
Score	0.91	1.94	0.42	-1.33	-0.90	1.19	-1.23	-0.06	-0.26
	> 0.20 High Probability			0.20 to - 0.24 Intermediate Probability			< -0.24 No Manipulation		

Figure 15. Ricoh India’s Vladu, Amat and Cuzdriorean Z Score from 2009 to 2018

Fraud F Score

Since the years 2011-2013, the risk of fraud has remained high for Ricoh India. After 2011, the F score was higher than 1.85 (see figure 16). But as the time came closer to the year of manipulation, the risk increased too much, specially in 2014 and 2015. Again, red flags were present some years before 2015.

Figure 16. Ricoh India’s Fraud F Score from 2010 to 2018

In summary, we have found that most of the techniques used provided clear red flags, anticipating a high probability that Ricoh India could have manipulated the accounts (see figure 17). Most of the red flags are clear some years before the scandal was reported by the media.

Average F-score = 0.728	18-17	17-16	16-15	15-14	14-13	13-12	12-11	11-10
Year t	2018	2017	2016	2015	2014	2013	2012	2011
Rsst_acc	-0.41	0.40	-1.02	-0.08	0.15	-0.35	-0.14	-0.02
deltaAR	-0.11	-0.01	-0.05	0.32	0.17	0.16	0.14	0.00
deltaINV	-0.07	-0.08	0.17	-0.01	0.06	0.15	0.07	0.10
Percentage of soft assets	0.82	0.94	0.94	0.90	0.87	0.86	0.76	0.80
deltaCashSales	-0.30	0.13	-0.16	0.42	0.67	0.41	0.31	0.17
Change rate of Return on Asset	-0.37	0.49	-0.68	0.01	0.02	0.01	-0.08	-0.02
Issue	1	1	1	1	1	1	1	0
Logit	-5.63	-5.24	-5.13	-4.30	-4.42	-4.81	-4.91	-6.17
Prob(FFR) = e^logit / (1 + e^logit)	0.0036	0.0053	0.0059	0.0134	0.0119	0.0081	0.0073	0.0021
F-score	0.9705	1.4315	1.5862	3.6186	3.2055	2.1809	1.9839	0.5630
	F-score > 2.45, Very high risk F-score > 1.85, High risk F-score >= 1, Risk above normal level F-score < 1, The risk is normal or below normal							

	Technique	Red flag in Ricoh India	Year of the red flag
Ratio analysis and	Difference between profit and cash	Very clear	2011
	Sloan Ratio	Very clear	2011
	Liquidity Ratio	-	-

³⁶ KRISHNAN, “Trouble at Ricoh: a lot like Satyam”, *The Hindu Business Line*, February 16, 2018.

Law of anomalous numbers	Debt Ratio	Very clear	2013
	Benford's Law	-	-
Statistical analysis	Altman Z Score	-	-
	Beneish M Score	Very clear	2009
	Vladu, Amat and Cuzdiorean Z Score	Very clear	2012/2013
	Fraud F Score	Very clear	2013/2014

Figure 17. Summary of the red flags found for Ricoh India

4. CONCLUSIONS

In this economic article, we have proposed several accounting fraud detection techniques and they have been applied to the case of Ricoh India, which had a great accounting scandal in 2015.

The main contribution of this work is to demonstrate that using the set of proposed techniques it is possible to detect accounting fraud. In principle, when a company has several warning signs, it could be concluded that the company has a high probability that the company has the accounts manipulated. Furthermore, the proposed techniques have also been found to allow the signals to be detected several years before the deception is public. In this way, the negative consequences of this type of fraud can be minimized.

These techniques can be of great use to managers, auditors, analysts, investors, supervisors and other stakeholders in their desire to avoid the negative consequences of accounting fraud.

From this study, we can suggest that an accounting database can be built to allow automated analysis of a large number of companies. Almost instantly, those with more red flags can be identified. These companies are the ones that should be analysed further since they have a high probability that they are companies that have manipulated their accounts.

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6. APPENDIX

Appendix 1. Ricoh’s balance sheets (2009-2018)

Balance Sheet	Mar '18	Mar '17	Mar '16	Mar '15	Mar '14	Mar '13	Mar '12	Mar '11	Mar '10	Mar '09
ASSETS										
Fixed Assets	45.68	64.26	67.39	64.23	73.87	42.39	37.26	15.85	16.24	11.07
Tangible Assets	45.68	64.26	67.39	64.23	73.87	42.39	37.26	15.85	16.24	11.07
Intangible Assets	0	0	0	0	0	0	0	0	0	0
Investments	0	0	0	0	0	0	0	0	0	0
Current Assets	1,380.56	1,879.49	2,065.35	1,230.65	786.41	702.24	340.79	238.08	188.43	170.49
Loans and Advances	584.31	943.21	945.8	302.4	222.48	291	115.77	97.55	68.05	53.15
Sundry Debtors	375.78	552.96	567.8	661.9	319.18	184.23	97.21	53.74	53.95	50.1
Cash Equivalents	210.72	50.04	59.81	70.39	38.34	72	54.41	36.39	35.21	18.4
TOTAL ASSETS	1426.24	1943.75	2132.74	1294.88	860.28	744.63	378.05	253.93	214.67	181.56
LIABILITIES										
Equity	-1,046.41	-152.66	-949.14	168.60	139.79	122.56	123.88	131.64	115.26	98.02
Total Share Capital	39.77	39.77	39.77	39.77	39.77	39.77	39.77	39.77	39.77	39.77
Reserves	-1,086.18	-192.43	-988.91	128.83	100.02	82.79	84.11	91.87	75.49	58.25
Current Liabilities	977.37	1,030.38	736.91	424.76	363.16	367.58	139.46	122.29	99.42	83.54
Provisions	12.5	33.21	71.91	26.17	14.3	5.16	5.97	5.65	4.8	3.77
Total Debt	1,495.28	1,066.03	2,345.01	701.52	357.33	254.49	114.71	0	0	0
Secured Loans	1,495.28	1,066.03	0	182	0	0	0	0	0	0
Unsecured Loans	0	0	2,345.01	519.52	357.33	254.49	114.71	0	0	0
TOTAL LIABILITIES	2472.65	2096.41	3081.92	1126.28	720.49	622.07	254.17	122.29	99.42	83.54
LIABILITIES & EQUITY	1426.24	1943.75	2132.74	1294.88	860.28	744.63	378.05	253.93	214.67	181.56

Appendix 2. Ricoh's income statements (2009-2018)

Income Statement	Mar '18	Mar '17	Mar '16	Mar '15	Mar '14	Mar '13	Mar '12	Mar '11	Mar '10	Mar '09
Sales Turnover	680.59	1,217.48	998.24	1,637.82	1,048.65	633.11	431.52	296.61	256.53	241.93
Other Income	-529.62	9.21	-554	16.8	1.82	1.53	1.73	1.43	2.86	-5.46
Stock Adjustments	-123.53	-158.66	295.98	-10.45	51.4	81.61	18.06	22.35	-17.82	16.42
COGS	568.39	885.83	916.96	1243.03	790.79	517.65	289.09	193.64	127.98	150.22
Employee Cost	104.63	123.88	125.39	101.05	89.02	78.75	66.08	43.08	38.66	36.9
Selling and Admin Expenses	2.07	0.47	27.37	0	0	0	0	0	35.19	31.37
Miscellaneous Expenses	159.09	218.85	625.1	142.81	144.07	97.4	85.55	54.25	8.1	7.81
PBDIT	-806.74	-161	-954.6	157.28	77.99	22.45	10.59	29.42	31.64	26.59
Interest	69.05	154.7	137.48	85.35	31.72	13.97	5.75	0.37	0.85	0.76
Depreciation	17.36	17.5	17.01	21.44	16.15	8.09	7.31	3.61	2.96	2.54
Tax	0.95	-6.6	8.64	16.59	12.89	1.71	0.14	9.06	10.55	6.24
Reported Net Profit	-894.1	-326.6	-1,117.73	33.9	17.23	-1.32	-2.61	16.38	17.24	12.54
Total Value Addition	269.45	346.73	781.15	246.96	235.41	177.73	152.98	98.38	82.96	76.12
Equity Dividend	0	0	0	3.98	0	0	0	0	0	0
Corporate Dividend Tax	0	0	0	0.81	0	0	0	0	0	0
Per share data (annualised)										
Shares in issue (lakhs)	397.68	397.68	397.67	397.67	397.67	397.67	397.67	397.67	397.67	397.67
Earning Per Share (Rs)	-224.83	-82.13	-281.07	8.52	4.33	-0.33	-0.66	4.12	4.33	3.15
Equity Dividend (%)	0	0	0	10	0	0	0	0	0	0
Book Value (Rs)	-263.13	-38.39	-238.68	42.4	35.15	30.82	31.15	33.1	28.98	24.65

Appendix 3. Ricoh's cash flow statements (2009-2018)

Cash Flow Statement	Mar '18	Mar '17	Mar '16	Mar '15	Mar '14	Mar '13	Mar '12	Mar '11	Mar '10	Mar '09
Net Profit Before Tax	-893.15	-333.2	-1109.09	50.49	30.12	0.39	-2.47	25.43	27.8	19.6
Net Cash From Operating Activities	-32.25	171.18	0	-222.45	-58.85	-96.67	-63.02	-9.44	35.39	-9.26
Net Cash (used in)/from										
Investing Activities	-25.53	-56.1	0	-14.26	-50.2	-14.72	-31.96	7.63	-17.71	-2.69
Net Cash (used in)/from Financing Activities	166.28	-120.36	0	265.06	72.11	126.97	108.88	-0.17	-0.67	-3.3
Net (decrease)/increase In Cash and Cash Equivalents	108.5	-5.28	-16.83	28.35	-36.94	15.58	13.9	-1.98	17.01	-15.24
Opening Cash & Cash Equivalents	35.55	40.83	57.74	29.35	66.2	50.62	40.51	38.37	21.37	36.61
Closing Cash & Cash Equivalents	144.05	35.55	40.91	57.7	29.26	66.2	54.41	36.39	38.37	21.37