OPEN ACCESS

Volume: 8

Special Issue: 1

Month: February

Year: 2021

P-ISSN: 2321-4643

E-ISSN: 2581-9402

Impact Factor: 3.122

Received: 18.01.2021

Accepted: 22.02.2021

Published: 26.02.2021

Citation:
Rangapriya, S., and J. Meenakumari. "Using Piotroski F-Score for Assessing Financial Health: Evidence from Leading Indian Private Banks." *Shanlax Interntional Journal of Management*, vol. 8, no. S1, 2021, pp. 117–32.

DOI:
https://doi.org/10.34293/management.v8iS1-Feb2021.3765

Using Piotroski F-Score for Assessing Financial Health: Evidence from Leading Indian Private Banks

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Abstract

This research investigates the efficacy of Piotroski F-score to screen firms with good financial health and to identify early signs of financial distress in Indian banking stocks. This study complements existing empirical evidence which indicate that the venerable model can provide valuable insight for investment decision making and risk management.

The evidence is drawn from valuation signals across leading private banks in India for a period ranging from 2014-2020. Piotroski F-score evaluates companies with a discrete number between zero and nine, the score facilitates determination of financial strength of the company. Higher score indicates better financial health and viceversa. The F-score is calculated as a sum of criteria which evaluates profitability signals, leverage and liquidity, sources of funds and operating efficiencies. In this study, each of these ratios have been analyzed to gain valuable insight on the banks (company-level). Analysis of Variance (ANOVA) of various ratios, ascertains intensity of relationship across banks (industry-level). This can help manage exposure in the portfolio as per the economic environment.

The Piotroski F-score evaluates the generic financial health of the firm and indicates the direction in which the firm is headed. By studying individual factors, relative strength can be assessed. Piotroski F-score ranged between 0-7 for all the banks under study, indicating that none of them were a 'compellingbuy' (score 8 or 9) over the seven-year horizon. Some banks have consistently shown depleting F-score over at least 3 years, this can be interpreted as a signal of financial distress. It is evident that consistent monitoring of F-score empowers pro-active risk management.

This work attempts to introduce Piotroski F-score as an integral valuation metric in evaluating Indian banking stocks. F-score can be used for initial screening, it's consistent monitoring can facilitate optimized returns at risk-adjusted levels.

Keywords: Piotroski, Indian Private Banks, F-score, Valuation, Risk Management

Introduction

Banking is the heartland of any economic growth, many recent crises in Indian private banks have put them in the spotlight and re-iterated the need to assess their fundamental health and position in the portfolio.

In the paper, "Valuing Financial Service Firms", it was rightly observed that two main challenges whilst valuing financial services companies (including banks) was estimation of cashflows and assessment of value shifts amidst change in regulatory environment (Damodaran, 2009). The three aspects which differentiate a banking company from a non-financial company are: high leverage, core business involves transformation of monies collected into other financial products for a different customer base and capital structure of banks is heavily regulated by central bank and other authorities (Massari, Gianfrate, & Zanetti, 2014).

This study analyses if Piotroski F score can be used as a metric to evaluate the financial health of private banks in India. This metric uses historical financial statements and assesses the accounting fundamentals including leverage, profitability, liquidity, operating cash flow etc., Financial distress is evident in companies with consistently declining or low levels of profitability, liquidity, cash flow (Piotroski,2000).

Piotroski F Score

This valuation metric was first introduced by Piotroski (2000), to ascertain if applying specific fundamental analysis technique across high book-to-market stocks increase could invest or returns substantially. The findings included that there could be substantially higher returns generated by choosing to invest in stocks with higher F-score.

Piotroski F score use snine fundamental ratios to measure the financial health of companies. These ratios make an assessment under three different categories: Profitability, Financial leverage/ liquidity and Operating Efficiency.

Table 1

Factor	Parameter	Definition	Calculation	Criteria for score
Profitability				
F1	ROA	Return on Assets	(Net Income before extraordinary items) / (Total assets at the beginning of the year)	If ROA >0, Score 1 else 0
F2	CFO	Cash flow from operations	(Cash from operations) / (Total assets at the beginning of the year)	If CFO >0, Score 1 else 0
F3	∆ ROA	Change in Return on Assets	(Current year ROA) - (Previous year ROA)	If ∆ ROA > 0, Score 1 else 0
Leverage, liquidity and source of funds				
F4	Accrual	Unrealised Earnings	Cash from Operations - Return on Assets	If Accrual > 0, Score 1 else 0
F5	∆ Leverage	Change in Leverage	(Currentyearlongtermdebts/ AverageTotalAssets for last 2 years) - (Previous year long term debts / Average Total Assets for last 2years)	If ∆ Leverage > 0, Score 0 else 1
F6	∆ Liquid	Change in liquidity	Current Ratio of current year - Current Ratio of previous year	If ∆ Liquid > 0, Score 1 else 0
F7	Equity Capital	Amount of Equity Offered in the CY	Current year outstanding shares - Previous year outstanding shars	If ∆ Equity capital >= 0, Score 0 else 1

F8	Δ Margin	Change in Gross Margin	Gross margin ratio of current year / Gross margin ratio of previous year	If Δ Margin > 0, Score 1 else 0
F9	Δ Turnover	Change in Turnover	Current year asset turnover ratio - Previous year asset turnover ratio	If Δ Turnover > 0, Score 1 else 0

Source: Inputs from (Piotroski, 2000)

$$\text{Piotroski F-score} = \sum_{n=1}^{9} F_n$$

Table 2

Assessment criteria	Ratio	Description
Assessment of profitability	Return on Assets (ROA)	Evaluates companies' ability to employ available resources to maximize profits
	Cash flow from operations (CFO)	Appraisal of ability to generate cash for consistent growth of the company. Higher cashflow can indicate improved earnings, reduced overheads and better efficiency
	Δ Return on Assets (Δ ROA)	Indicates increase in profitability by better utilization of available resources
Assessment of leverage, liquidity and source of funds	Accruals	This refers to the unrealized earnings, any company with high accruals is subject to default risk. This increases the risk aspect substantially. This factor is calculated as (Net Income before extraordinary items – cash flow from operations)/ Total assets. Alternatively,the calculation of ROA and CFO is used for evaluating scoring criteria.
	Δ Leverage	This measures the increase or decrease in longterm debt over the past year. The increase of long term debt constrains the free oper ability of the company
	Δ Liquid	The increase or decrease in the companies' ability to pay off its immediate short- term debts using assets which are easily convertible to cash. An increase in such ability is preferred.
	Δ Equity	It measures the change in dilution of ownership (if any). A company whichhas managed to grow without dilution of ownership is preferred to one where there has been fresh issue of capital.
Assessment of operational efficiency	Δ Margin	Improvement in margin means reduced direct overheads and improved efficiency or the topline growth rate is significantly higher than the direct expense escalation rate.
	Δ Turnover	Efficiency of company to utilize its assets to drive topline growth is measured.

Source: Piotroski, (2000)

Limitations and challenges in implementing Piotroski F-score

Piotroski F-score has stood the test of time for over two decades; however, it is not fraught from limitations and criticism.

- Piotroski F-score requires enormous amount of accounting information and needs to be studied across multiple years to enable meaningful interpretation
- Modelis dependent on financial ratios, which is prone to 'proliferation and vagueness 'and the interpretations are subjective. Difference in accounting policies tend to impact the representation of financial statements, thus reducing the comparability of financial ratios across companies (Wadhwa,2019)
- Banks are inherently debt-heavy due to the nature of the business, study of ratios in conjunction with other industries may lead to misinterpretation
- Despite the challenges, ithase merged as a fundametal valuation metric which potentially increases the decision making and risk management.

Literature Review

The land mark paper by Piotroski(2000),haspiquedtheinterestofacademiciansacrosstheworld. It has provided a new dimension to assess value stocks, financial health and predict bankruptcy. Traditionally, Piotroski F score is tested on stocks with high book-to-market value, however, Mohr (2012) tested the score on growth stocks. In his work, he observes that Piotroski F score can bean effective way to construct a market-neutral portfolio to yield higher returns. It increases the explanatory power of a multivariate regression analysis on market-adjusted returns and variance. In their paper, Krauss, Krüger, & Beerstecher (2015), made an assessment of Piotroski F score fromaninvestor'sperspective.TheyimplementedtheF-scorestrategyonUSstockuniversefora period from 2005-2010. While on excluding aspects such as low liquidity and transaction costs, theF-sco restrategyenabledoutperformancevis-à-visbenchmark.Oninclusionofconstraints,the strategy could not hold mettle. However, the paper concluded that in an environment with no liquidity constraints, the strategy could hold potential.

As per Hyde (2016), implementation of F-score to identify stocks with good financial health resulted in optimising returns. The test was carried out on S&P and ASX 200 stocks. The paper indicates that further research in understanding the correlation of F-score with other key factors could enable stakeholders to utilise the signals of financial distress better.

Piotroski F-score was tested for its effectiveness across the world, including countries like Mexico and Finland. In the case of Mexico, F-score was compared alongside Ohlson Model on a set of63 Mexican stocks for the period 2005-2011. The paper concluded that F-score is a significant financial tool which provides insight on the financial health (present and past) of the company. In another study conducted on Finnish Stock Market for the period 2004 – 2015, portfolios were constructed using F-score, with the underlying hypothesis that higher F-score could potentially generate higher risk – adjusted returns. The paper concluded by stating that the hypothesis held ground and exhibited premium returns (Duran-Vazquez, Lorenzo-Valdes, & Castillo-Ramirez, 2014) (Kansanen, 2016).

Apaper studying the impact of F score on Indian Equity market for the period 2010–2015 across 500 companies, concluded that inclusion of high book to market and high F score stocks can favorably shift contemporaneous and future performance for the investor. The study analyses impact of F-score on projected stock returns, return on equity, market-to-book-value.Thefindings indicate that F-score offers insight when used as a tool for valuation of stock (Tripathy & Pani, 2017).

Another similar study which studied the stocks listed on Bombay Stock Exchange (BSE),

excluding financial companies, over a period of 15 years (1996-2010). A significant annual difference of 29.856% was observed across the two portfolios (high F score and low F score). This paper concludes that implementation of F score helps in achieving higher returns at risk adjusted levels (Kaur, 2015). On finding favorable evidence while being tested for genre / style of investment (value, growth), the tests were extended to study individual sectors. In their paper, Mesarić, (2014) conducted Piotroski F-score analysis on 5 Croatian automobile distributors for the period 2007-2012. It was a detailed study to analyse the health of these companies and the industry as a whole. The paper concluded that F-score proved to be a preamble of stressful times. It was evidenced that investors could use this tool prior to making investment decisions especially from a medium – long term perspective.

Impact of F score on P/E ratio was studied on Pharma and Cement industry pertaining to Indian stock market. This work analyses the financial statements of leading companies in the sector, alongside F-score, the paper also conducts a detailed analysis on individual ratios. The impact of each of the financial ratios on Price / Earnings multiple for indiviudual company in the sector is analysed. Both the papers draw similar conclusions stating that, F-score is not swayed by any specific ratios from the financial statements of companies. However, it does indicate the general direction in which the companies fundamentals are headed and hence, can be used as an initial screening tool to weed out companies with financial distress (Chakraborty, IMPACT OF PIOTROSKI SCORE ON P/E RATIO: A STUDY ON INDIAN CEMENT SECTOR, 2018) (Chakraborty, IMPACT OF F SCORE ON P/E RATIO: A STUDY ON INDIAN PHARMA COMPANIES, 2019).

Piotroski F score has also been used to detect financial distress, in the literary work by Agrawal (2015) analyses the effectiveness of Piotroski F score and the individual components to predict the riskofdefault.Thestudywasconductedacross135companiesforaperiodof 2000–2012.Higher F-score indicates lower probability of default, further, the leverage component was significant in predicting defaults.

There is enough empirical evidence, that Piotroski F score contributes significantly to optimise portfolio returns and mitigate risk. It is a leading indicator of financial health in companies. To the best four knowledge, there has been no study conducted exclusively to ascertain financial health of leading Indian private banks.

Research Methodology

Objective

- Estimate the relevance of Piotroski F score as a screening method to identify financially healthy firms
- To assess the change in Piotroski F Score of leading Indian private banks from years 2014-2020 and ascertain if there are signs of financial distress

Data source

This study is an analysis of secondary data-various existing literature, articles, publicly available data were studied, they have been duly credited.

Calculating accounting ratios of Piotroski F-score

The individual accounting ratios are calculated which later facilitate calculation of Piotroski F-score for the banks over the time period under consideration.

Assessment of profitability

a. Return on Assets(ROA)

BankName	2014	2015	2016	2017	2018	2019	2020	Average	Std.Dev
Axis Bank	1.85%	1.93%	1.79%	0.72%	0.07%	0.72%	0.23%	1.04%	0.008
City Union Bank	1.51%	1.58%	1.60%	1.58%	1.68%	1.71%	1.05%	1.53%	0.002
DCB Bank	1.34%	1.48%	1.21%	1.04%	1.02%	1.08%	0.94%	1.16%	0.002
Dhanlaxmi Bank	-1.82%	-1.64%	-1.46%	0.10%	-0.20%	0.09%	0.56%	-0.62%	0.010
Federal Bank	1.20%	1.42%	0.59%	0.92%	0.81%	0.95%	0.98%	0.98%	0.003
HDFC Bank	2.14%	2.12%	2.11%	2.00%	2.07%	2.02%	2.11%	2.08%	0.001
ICICI Bank	1.64%	1.64%	1.23%	1.11%	0.78%	0.38%	0.77%	1.08%	0.005
IndusInd Bank	1.92%	2.06%	2.05%	2.01%	2.02%	1.49%	1.59%	1.88%	0.002
Jammu Kashmir Bank	1.65%	0.65%	0.55%	-2.03%	0.25%	0.52%	-1.17%	0.06%	0.012
Karur Vysya Bank	0.92%	0.90%	1.07%	1.03%	0.56%	0.32%	0.34%	0.73%	0.003
Kotak Mahindra Bank	2.13%	2.49%	2.33%	2.05%	2.25%	2.13%	2.17%	2.22%	0.001
South Indian Bank	1.02%	0.56%	0.56%	0.62%	0.45%	0.30%	0.11%	0.52%	0.003
Yes Bank	1.63%	1.83%	1.86%	2.02%	1.97%	0.55%	-4.31%	0.79%	0.023

Key Observations

- Kotak Mahindra Bank, HDFC Bank have accorded the highest average return on assets with 2.22% and 2.08%respectively
- Yes Bank have been under distress with a decreasing trend over the past 3 years(2018–2020)

Hypothesis

H0 = ROA of leading Indian private banks do not differ significantly across banks over the years
H1=ROA of leading Indian private banks differ significantly across banks over the years in at least one instance

Table 4 Analysis of Variance (ANOVA)

Source of Variation	SS	df	MS	F	P-value	F crit
Between Groups	0.0053	12	0.0004	6.3408	0.0000	1.8785
Within Groups	0.0055	78	0.0001			
Total	0.0108	90				

Since p-value <0.05 and F criteria is at 1.8785 which is lower than F-value 6.3408, H0 is rejected.

b. Cash Flow from Operations (CFO)

Table 5

Bank Name	2014	2015	2016	2017	2018	2019	2020	Aver-age	SD
Axis Bank	0.04	(0.04)	(0.07)	0.06	(0.06)	0.05	0.04	0.00	0.06
City Union Bank	0.02	0.01	0.01	0.01	(0.01)	0.01	0.04	0.01	0.01
DCB Bank	0.04	(0.04)	0.01	0.01	0.01	(0.01)	0.00	0.01	0.02
Dhanlaxmi Bank	0.05	(0.04)	(0.02)	(0.01)	(0.02)	(0.01)	0.05	(0.00)	0.03

Federal Bank	0.02	0.07	(0.02)	0.04	(0.04)	0.06	0.02	0.02	0.04
HDFC Bank	0.01	(0.04)	(0.06)	0.02	0.02	(0.06)	(0.01)	(0.02)	0.04
ICICI Bank	0.01	(0.02)	0.03	0.06	0.02	0.04	0.06	0.03	0.03
IndusInd Bank	(0.06)	(0.02)	(0.03)	0.08	(0.12)	(0.03)	(0.04)	(0.03)	0.06
Jammu Kashmir Bank	(0.01)	0.00	(0.00)	0.03	0.03	(0.03)	0.04	0.01	0.03
Karur Vysya Bank	0.03	(0.01)	0.01	0.03	(0.01)	(0.02)	0.04	0.01	0.02
Kotak Mahindra Bank	0.08	0.02	0.03	0.05	(0.04)	0.01	0.12	0.04	0.05
South Indian Bank	0.02	0.01	0.00	0.03	0.01	0.02	0.01	0.01	0.01
Yes Bank	0.04	(0.02)	(0.00)	0.03	(0.10)	(0.08)	(0.15)	(0.04)	0.07

Key observations

- South Indian Bank is the only bank which has consistently posted positive cashflow from operations over the tenure
- Kotak Mahindra Bank has the highest average cash flow from operations
- Yes Bank, IndusInd Bank have shown negative cash flow from operations across most years

Hypothesis

H0 = CFO of leading Indian private banks do not differ significantly across banks over the years
H1=CFOofleadingIndianprivatebanksdiffersignificantlyacrossbanksovertheyearsinatleast one instance

ANOVA

Table 6

Source of Variation	SS	df	MS	F	P-value	F crit
Between Groups	0.0412	12	0.0034	2.0737	0.0283	1.8785
Within Groups	0.1293	78	0.0017			
Total	0.1705	90				

Since p-value <0.05 and F criteria is at 1.8785 which is lower than F-value 2.074, H0 is rejected.

c. Change in Return on Assets (ROA)

Table 7

Bank Name	2014	2015	2016	2017	2018	2019	2020	Average	SD
Axis Bank	0.02%	0.07%	-0.14%	-1.06%	-0.65%	0.64%	-0.49%	-0.23%	0.01
City Union Bank	-0.25%	0.07%	0.02%	-0.01%	0.10%	0.03%	-0.66%	-0.10%	0.00
DCB Bank	0.17%	0.14%	-0.27%	-0.16%	-0.02%	0.06%	-0.13%	-0.03%	0.00
Dhanlaxmi Bank	-1.84%	0.18%	0.18%	1.56%	-0.30%	0.30%	0.46%	0.08%	0.01
Federal Bank	-0.21%	0.22%	-0.83%	0.33%	-0.11%	0.14%	0.04%	-0.06%	0.00
HDFC Bank	0.13%	-0.02%	-0.01%	-0.10%	0.07%	-0.05%	0.08%	0.01%	0.00
ICICI Bank	0.09%	0.00%	-0.41%	-0.12%	-0.33%	-0.40%	0.39%	-0.11%	0.00
IndusInd Bank	0.08%	0.14%	-0.02%	-0.04%	0.01%	-0.53%	0.10%	-0.04%	0.00
Jammu Kashmir Bank	-0.10%	-1.00%	-0.10%	-2.58%	2.28%	0.27%	-1.68%	-0.42%	0.02

Karur Vysya Bank	-0.54%	-0.02%	0.17%	-0.04%	-0.47%	-0.24%	0.02%	-0.16%	0.00
Kotak Mahindra Bank	-0.24%	0.36%	-0.16%	-0.28%	0.19%	-0.11%	0.04%	-0.03%	0.00
South Indian Bank	-0.22%	-0.46%	0.01%	0.05%	-0.17%	-0.15%	-0.19%	-0.16%	0.00
Yes Bank	-0.14%	0.21%	0.03%	0.16%	-0.05%	-1.42%	-4.86%	-0.87%	0.02

Key Observations

- Yes Bank and Jammu Kashmir Bank have shown severe drop in return on assets.
- Except HDFC Bank and Dhanlaxmi Bank, all the banks have seen a negative average change in ROA

Hypothesis

H0= ROA of leading Indian private banks do not differ significantly across banks over the years
H1 = ROA of leading Indian private banks differ significantly across banks over the years in atleast one instance

ANOVA

Table 8

Source of Variation	SS	df	MS	F	P-value	F crit
Between Groups	0.0412	12	0.00004	0.70918	0.73807	1.87848
Within Groups	0.00464	78	0.00006			
Total	0.00515	90				

Since p-value >0.05 and F criteria [1.87848] > F factor [0.70918], we do not reject H0.

Leverage, Liquidity and Source of Funds

d. Accruals

Table 9

Bank Name	2014	2015	2016	2017	2018	2019	2020	Average	SD
Axis Bank	0.024	(0.059)	(0.092)	0.052	(0.064)	0.046	0.035	(0.008)	0.06
City Union Bank	0.003	(0.011)	(0.007)	(0.007)	(0.022)	(0.007)	0.030	(0.003)	0.02
DCB Bank	0.030	(0.053)	0.002	0.002	(0.001)	(0.020)	(0.005)	(0.006)	0.03
Dhanlaxmi Bank	0.065	(0.025)	(0.006)	(0.009)	(0.014)	(0.013)	0.041	0.006	0.03
Federal Bank	0.005	0.055	(0.025)	0.027	(0.052)	0.047	0.013	0.010	0.04
HDFC Bank	(0.011)	(0.063)	(0.078)	0.003	(0.001)	(0.077)	(0.034)	(0.038)	0.04
ICICI Bank	(0.006)	(0.033)	0.016	0.046	0.012	0.040	0.057	0.019	0.03
IndusInd Bank	(0.075)	(0.037)	(0.047)	0.061	(0.136)	(0.044)	(0.059)	(0.048)	0.06
Jammu Kashmir Bank	(0.026)	(0.005)	(0.008)	0.051	0.026	(0.039)	0.055	0.008	0.04
Karur Vysya Bank	0.016	(0.015)	0.000	0.017	(0.014)	(0.027)	0.033	0.001	0.02
Kotak Mahindra Bank	0.057	(0.006)	0.011	0.034	(0.060)	(0.016)	0.096	0.017	0.05
South Indian Bank	0.008	0.007	(0.004)	0.025	0.006	0.017	0.006	0.009	0.01
Yes Bank	0.028	(0.040)	(0.021)	0.006	(0.121)	(0.084)	(0.108)	(0.048)	0.06

Key Observations

- Kotak Mahindra Bank, ICICI Bank have the highest average of excess of CFO overROA, indicating that their resource utilization ability is higher
- Yes Bank and IndusInd Bank have the lowest average on this front

Hypothesis

H0=Accrual of leading Indian private banks do not differ significantly across banks over the years
H1 = Accrual of leading Indian private banks differ significantly across banks over the years in atleast oneinstance

ANOVA

Table 10

Source of Variation	SS	df	MS	F	P-value	F crit
Between Groups	0.04608	12	0.00004	2.41313	0.01025	1.87848
Within Groups	0.12412	78	0.00159			
Total	0.17021	90				

Since p-value <0.05 and F criteria [1.87848] < F factor [2.41313], we reject H0.

e. Leverage

Table 11

Bank Name	2014	2015	2016	2017	2018	2019	2020	Average	SD
Axis Bank	(0.06)	0.05	(0.01)	(0.07)	0.02	0.03	(0.03)	(0.01)	0.04
City Union Bank	(0.18)	(0.07)	0.04	(0.03)	0.00	0.00	(0.03)	(0.04)	0.07
DCB Bank	(0.11)	0.02	(0.03)	0.06	0.03	(0.05)	(0.12)	(0.03)	0.07
Dhanlaxmi Bank	0.06	(0.01)	(0.14)	0.05	0.06	(0.03)	0.04	0.01	0.07
Federal Bank	(0.13)	0.01	0.07	0.10	0.01	(0.06)	(0.03)	(0.00)	0.08
HDFC Bank	0.02	0.00	0.03	(0.05)	0.05	(0.05)	0.03	0.00	0.04
ICICI Bank	(0.01)	0.00	0.01	(0.05)	0.05	(0.01)	0.01	0.00	0.03
IndusInd Bank	(0.08)	0.03	0.01	(0.02)	0.01	0.03	(0.16)	(0.03)	0.07
Jammu Kashmir Bank	(0.10)	(0.17)	0.02	0.02	0.06	0.07	(0.03)	(0.02)	0.09
Karur Vysya Bank	(0.18)	(0.15)	0.04	(0.02)	(0.01)	(0.03)	(0.07)	(0.06)	0.08
Kotak Mahindra Bank	(0.21)	0.05	0.45	(0.27)	(0.09)	(0.02)	(0.06)	(0.02)	0.24
South Indian Bank	(0.13)	(0.08)	(0.01)	0.09	(0.01)	(0.02)	(0.06)	(0.03)	0.07
Yes Bank	(0.22)	0.02	0.04	0.03	0.25	(0.18)	(0.64)	(0.10)	0.28

Key Observations

- Dhanlaxmi Bank, HDFC Bank, ICICI Bank saw an average increase (albeit marginal) in change in leverage over theyears
- Most banks had an increase in long term debt across the years, but the corresponding increase in assets has been higher indicating that the funds have been prudently used to achieve long term benefits

Hypothesis

H0 = Leverage of leading Indian private banks do not differ significantly across banks over the years

H1 = Leverage of leading Indian private banks differ significantly across banks over the years in atleast one instance

ANOVA

Table 12

Source of Variation	SS	df	MS	F	P-value	F crit
Between Groups	0.07025	12	0.00585	0.40924	0.95588	1.87848
Within Groups	1.11579	78	0.01431			
Total	1.18604	90				

Since p-value >0.05 and F criteria [1.87848] > F factor [0.40924], we do not reject H0.

f. Liquidity

Table 13

Bank Name	2014	2015	2016	2017	2018	2019	2020	Average	SD
Axis Bank	(1.71)	3.66	(2.21)	(2.58)	2.16	(0.91)	(1.18)	(0.40)	2.37
City Union Bank	(2.52)	(5.76)	3.26	(0.05)	0.26	(1.81)	0.63	(0.86)	2.85
DCB Bank	(4.31)	(0.00)	(3.83)	2.29	1.98	2.19	5.08	0.49	3.45
Dhanlaxmi Bank	(9.42)	10.93	(7.34)	8.75	1.22	(1.97)	(8.83)	(0.95)	8.33
Federal Bank	(4.43)	9.12	(0.16)	3.46	6.50	(3.95)	2.21	1.82	5.07
HDFC Bank	0.62	4.39	1.45	(3.26)	6.16	(0.69)	(0.35)	1.19	3.19
ICICI Bank	0.21	0.09	0.29	(0.34)	0.01	(0.17)	0.28	0.05	0.24
IndusInd Bank	(1.45)	(9.91)	1.20	0.73	5.99	2.59	(0.26)	(0.16)	4.91
Jammu Kashmir Bank	0.09	1.54	(3.69)	(3.99)	13.81	(6.18)	0.92	0.36	6.59
Karur Vysya Bank	(0.19)	(1.83)	(0.02)	3.14	2.52	(0.02)	0.30	0.56	1.71
Kotak Mahindra Bank	(0.17)	(0.18)	1.48	0.27	0.19	(0.27)	0.25	0.22	0.60
South Indian Bank	(0.82)	3.43	4.95	1.78	7.43	(1.67)	1.63	2.39	3.18
Yes Bank	0.29	2.44	1.24	(0.06)	7.67	(5.73)	(3.65)	0.31	4.32

Key Observations

- South Indian Bank and Federal bank have recorded highest average liquid
- Dhanlaxmi Bank has had random and relatively high fluctuations in liquidity over theyears
- Most other banks are placed comfortably in terms of liquidity

Hypothesis

H0 = Liquid of leading Indian private banks do not differ significantly across banks over the years

H1 = Liquid of leading Indian private banks differ significantly across banks over the years in atleast one instance

ANOVA

Table 14

Source of Variation	SS	df	MS	F	P-value	F crit
Between Groups	78.0679	12	6.50565	0.36691	0.97128	1.87848
Within Groups	1383.03	78	17.73111			
Total	1461.09	90				

Since p-value >0.05 and F criteria [1.87848] > F factor [0.36691], we do not reject H0.

g. Equity Offer

Table 15

Bank Name	2014	2015	2016	2017	2018	2019	2020
Axis Bank	1,890,085	1,900,677,646	12,309,627	12,204,283	171,502,827	5,105,935	250,033,063
City Union Bank	3,800,405	53,827,537	1,623,479	2,873,602	63,664,328	69,771,609	2,818,403
DCB Bank	213,025	31,687,651	2,423,800	928,280	22,720,530	1,462,015	868,515
Dhanlaxmi Bank	40,798,300	51,507,000	-	32,405,000	43,165,465	-	-
Federal Bank	684,252,653	1,343,412	862,291,647	5,098,570	248,099,025	12,905,764	7,614,369
HDFC Bank	19,631,405	107,444,882	21,691,200	34,359,200	32,544,550	128,216,343	2,759,979,850
ICICI Bank	1,251,054	4,642,411,876	17,523,785	9,707,705	603,514,641	18,248,877	26,525,550
IndusInd Bank	2,768,778	4,003,725	65,536,126	3,162,370	2,074,482	2,463,681	90,848,870
Jammu Kashmir Bank	-	436,300,218	-	-	72,080,372	-	156,592,546
Karur Vysya Bank	-	14,448,503	234,845	487,457,816	117,317,101	72,671,576	9,772
Kotak Mahindra Bank	23,701,975	2,041,663	1,062,029,494	6,515,719	64,750,629	3,106,321	4,283,511
South Indian Bank	5,409,172	6,204,475	157,005	452,526,918	5,995,121	851,071	40,000
Yes Bank	2,011,337	57,102,472	2,795,543	35,954,172	1,846,481,432	12,065,794	10,235,439,192

Key Observations

- Yes Bank and HDFC Bank saw the highest dilution over theyears
- Dhanlaxmi Bank, Karur Vysya Bank and South Indian Bank saw the least dilution of Equity capital

Hypothesis

H0 = Equity of leading Indian private banks do not differ significantly across banks over the years

H1 = Equity of leading Indian private banks differ significantly across banks over the years in atleast one instance

ANOVA

Table 16

Source of Variation	SS	df	MS	F	P-value	F crit
Between Groups	1.9E+19	12	1,619,824,675,052,300,000	1.08656	0.38307	1.87848
Within Groups	1.2E+20	78	1,490,777,058,900,730,000			
Total	1.4E+20	90				

Since p-value >0.05 and F criteria [1.87848] > F factor [1.08656], we do not reject H0. Thus, concluding that Equity offer of leading Indian private banks do not differ significantly over the years.

h. Change in Gross Margin

Table 17

Bank Name	2014	2015	2016	2017	2018	2019	2020	Average	SD
Axis Bank	(0.01)	0.00	(0.01)	(0.20)	(0.10)	0.14	(0.07)	(0.04)	0.10
City Union Bank	(0.02)	(0.01)	(0.01)	(0.05)	(0.03)	0.03	(0.10)	(0.03)	0.04
DCB Bank	0.01	(0.01)	(0.01)	(0.01)	(0.02)	0.05	(0.00)	(0.00)	0.02
Dhanlaxmi Bank	(0.15)	(0.03)	0.00	0.09	(0.08)	0.07	(0.02)	(0.02)	0.08
Federal Bank	(0.01)	0.01	(0.10)	0.01	(0.02)	0.03	(0.03)	(0.02)	0.04
HDFC Bank	0.03	(0.00)	0.00	(0.01)	(0.02)	0.01	(0.04)	(0.00)	0.02
ICICI Bank	0.04	(0.04)	(0.18)	(0.17)	(0.12)	0.01	0.16	(0.04)	0.12
IndusInd Bank	(0.03)	(0.01)	(0.03)	(0.04)	0.02	(0.04)	(0.02)	(0.02)	0.02
Jammu Kashmir Bank	0.02	(0.15)	(0.03)	(0.30)	0.19	0.03	(0.17)	(0.06)	0.16
Karur Vysya Bank	(0.07)	(0.01)	0.00	(0.06)	(0.12)	(0.04)	(0.02)	(0.05)	0.04
Kotak Mahindra Bank	0.02	(0.14)	0.16	(0.10)	(0.00)	0.01	(0.01)	(0.01)	0.10
South Indian Bank	0.01	(0.07)	0.00	(0.03)	(0.07)	0.03	(0.07)	(0.03)	0.04
Yes Bank	(0.03)	(0.01)	(0.03)	(0.04)	(0.03)	(0.07)	(1.11)	(0.19)	0.41

Key Observations

- All the leading Indian private banks have negative average growth in grossmargin
- Yes Bank recorded the highest de-growth in gross margin with a significant downturn in 2020 alone

Hypothesis

- H0 = Change in Gross Margin of leading Indian private banks do not differ significantly across banks over the years
- H1 = Change in Gross Margin of leading Indian private banks differ significantly across banks over the years in atleast one instance

ANOVA

Table 18

Source of Variation	SS	df	MS	F	P-value	F crit
Between Groups	0.23174	12	0	0.91777	0.53466	1.90437
Within Groups	1.36776	65	0			
Total	1.59951	77				

Since p-value >0.05 and F criteria [1.90437] > F factor [0.91777], we do not reject H0. Thus, concluding that change in Gross Margin of leading Indian private banks do not differ significantly over the years.

Operational Efficiency

i. Change in Turnover

Table 19

Bank Name	2014	2015	2016	2017	2018	2019	2020	Average	SD
Axis Bank	(0.0051)	0.0022	(0.0038)	(0.0059)	(0.0064)	0.0034	(0.0014)	(0.0024)	0.0040
City Union Bank	(0.0086)	(0.0028)	(0.0023)	(0.0058)	(0.0033)	(0.0021)	(0.0022)	(0.0039)	0.0024
DCB Bank	(0.0055)	0.0100	(0.0048)	0.0033	(0.0082)	0.0003	(0.0018)	(0.0010)	0.0062
Dhanlaxmi Bank	0.0043	(0.0060)	(0.0035)	0.0035	(0.0052)	(0.0031)	0.0046	(0.0008)	0.0047
Federal Bank	(0.0045)	0.0016	(0.0059)	(0.0017)	(0.0069)	(0.0023)	0.0011	(0.0026)	0.0033
HDFC Bank	(0.0008)	(0.0038)	0.0034	(0.0079)	(0.0006)	(0.0003)	(0.0008)	(0.0015)	0.0035
ICICI Bank	0.0008	0.0002	(0.0017)	(0.0054)	(0.0033)	0.0010	0.0045	(0.0006)	0.0032
IndusInd Bank	(0.0087)	(0.0012)	(0.0052)	(0.0054)	(0.0041)	0.0037	0.0032	(0.0025)	0.0046
Jammu Kashmir Bank	(0.0075)	(0.0045)	0.0003	(0.0068)	(0.0026)	0.0048	(0.0023)	(0.0026)	0.0043
Karur Vysya Bank	(0.0033)	(0.0048)	(0.0023)	(0.0071)	(0.0031)	(0.0053)	(0.0005)	(0.0038)	0.0022
Kotak Mahindra Bank	(0.0139)	0.0055	0.0284	(0.0447)	(0.0017)	(0.0027)	(0.0036)	(0.0047)	0.0220
South Indian Bank	(0.0091)	(0.0046)	(0.0021)	(0.0019)	(0.0088)	(0.0002)	0.0010	(0.0037)	0.0040
Yes Bank	(0.0119)	0.0054	(0.0068)	(0.0000)	(0.0052)	0.0006	(0.0264)	(0.0063)	0.0105

Key Observations

- The change in turnover was negative for most of the years across all the banks, the average change was insignificant

Hypothesis

- H0= Change in Turn over of leading Indian private banks do not differ significantly across banks over the years
- H1 = Change in Turnover of leading Indian private banks differ significantly across banks over the years in atleast one instance

ANOVA

Table 20

Source of Variation	SS	df	MS	F	P-value	F crit
Between Groups	0.00023	12	0	0.32557	0.98248	1.87848
Within Groups	0.00462	78				
Total	0.00485	90				

Since p-value >0.05 and F criteria [1.87848] > F factor [0.32557], we do not reject H0. Thus, concluding that change in turn over of leading Indian private banks do not differ significantly over the years.

Calculation of Piotroski F-score

Table 21

PIOTROSKI SCORE	2014	2015	2016	2017	2018	2019	2020
Axis Bank	5	5	2	4	2	6	4
City Union Bank	4	4	4	3	3	4	5
DCB Bank	6	3	4	5	3	6	4

Dhanlaxmi Bank	4	2	2	6	2	3	6
Federal Bank	4	7	1	6	2	6	7
HDFC Bank	6	3	5	3	5	2	3
ICICI Bank	7	4	4	4	4	6	7
IndusInd Bank	3	2	2	5	4	3	4
Jammu Kashmir Bank	4	4	2	2	6	4	4
Karur Vysya Bank	4	2	5	5	3	2	6
KotakMahindraBank	5	4	6	5	4	4	6
South Indian Bank	5	5	6	5	5	5	6
Yes Bank	5	4	3	4	2	3	1

Table 22

Bank Name	Interpretation
Axis Bank	It saw the lowest score in the years 2016 and 2018, and the highest score was in the year 2019. There is no consistent trend seen in this bank.
City Union Bank	While the score has been on the lower side, there has been some consistency and one can see an improving trend over the past 3 years.
DCB Bank	There have been two instances where the bank has scored 6 (2014 and 2019). Score has been in consistent
Dhanlaxmi Bank	One can see an increasing trend over the past 3 years. This bank has had 2 instances of score 6 (2017 and2020).
Federal Bank	This bank seems to have had good scores except the years 2016 and 2018 when the scores were very low.
HDFC Bank	There has been in consistency in the scores over the years. There has been a decreasing trend over the past 3years.
ICICI Bank	The score has been consistent with an increasing trend over past 3 years.
Indus Ind Bank	An inconsistent trend can be seen in this bank.
Jammu Kashmir Bank	There has been a downward to flat trend in the past 3 years.
Karur Vysya Bank	The F -score improved drastically in the year 2020. There is some inconsistency in the score on a year-on-year basis.
Kotak MahindraBank	This is one of the few banks where the F-score has oscillated within a narrow range. However, no consistent trend can be established.
South Indian Bank	The F-score has ranged between 5-6, with 2 instances of score 6 in 2016 and 2020. This bank has exhibited the highest degree of consistency.
Yes Bank	Over the last 4 years, the score has seen in an inconsistent downward trend. Along with Indus Ind Bank, this is the only other bank which has failed to cross over the mid-way mark of 5.

Result Discussion

Out the 91 counts F-scores across all the banks understudy and the 7 years tenure, ~82.14% of the times, the banks exhibited moderate financial health (score 3-7), ~18% the financials remained weak (score 0-2). While the individual F-score gives a generic view of the companies' financial

health. In the current study, it is apparent that there were redflags in Yes Bank. Also, the financials of IndusInd bank and Jammu Kashmir bank indicate that there is considerable stress. Among the private banks studied, Kotak Mahindra Bank and Federal Bank have exhibited relatively better financial health. Monitoring F-score on a consistent basis will help identify firms which are in distress, this metric is capable of providing early signs of financial stress.

Conclusion

Piotroski F-score is valuable metric for initial screening, which will eliminate the possibility of inclusion of fundamentally weak firms in the portfolio. Further, consistently monitoring the F-score will facilitate pro-active risk management. This score should be studied at an individual ratio level to gain deeper insight on the firm's problem areas, also, it is pertinent to study the Piotroski score in relation to the industry peers. The shortcomings such as possibility of misinterpretation incase of debt-heavy sectors such as banks can be countered by aligning the study of Piotroski F- score with other sector specific valuation metrics. The challenges of enormous accounting information requirement and elaborate / standardized calculation can be overcome with the aid of technology. This paper supports the evidence that inclusion of Piotroski F score as a screening metriccanhelpimprovedecisionmakingprocessandbuildapowerfulrisk–rewardmanagement technique.

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