



Research Article

MACHINE LEARNING TO CLASSIFY INDUSTRY STRESS DUE TO COVID-19 LOCKDOWN IN INDIA

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ABSTRACT

During the Covid-19 crisis the value chain, communication and cooperation amongst the business environment were disrupted. We have observed increasing uncertainty, untrustworthiness of sources; ambiguous interpretation of information led the estimation harder during this time.

We are expecting a dip of profit due to Covid-19 lockdown. In this paper we first worked on to build a model to classify industry stress low and high due to Covid-19 lockdown. Model is built following the two steps of processing like consensus input and exploratory data analysis. Python packages and scikit learn are used for analytics in this paper. Data available from NSE (VIX, Sectoral Index, stock price, index P/E) are used for return, volatility, and earning of index calculation.

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INTRODUCTION

Stress due to Covid-19 among the industries is not similar and unprecedented in India. US market stress is behaving a lot like 2008. In India we have no such experience to compare.

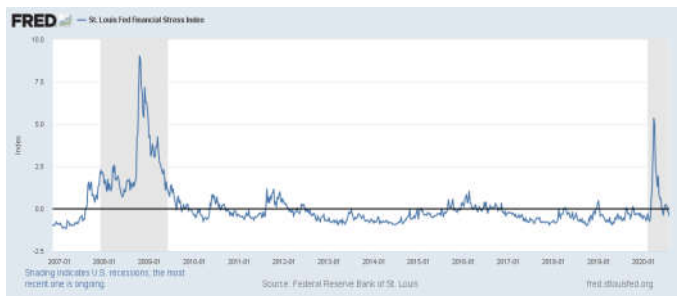


Figure 1 Source: Federal Reserve Bank of St. Louis, St. Louis Fed Financial Stress Index [STLFSI2], retrieved from FRED, Federal Reserve Bank of St. Louis; <https://fred.stlouisfed.org/series/STLFSI2>, July 31, 2020.

Recovering any corporate’s stress is very much dependent on internal corporate governance. According to Harvard Business Review data decisions made by chief financial officers and cost cuts of CxOs without changes of long-term investment decisions are important factors related to corporate governance. Size of firms can be considered as an important factor too. The size factor is nullified from our research by considering top NSE listed firms.

We have found 16 different industries as mentioned in NSE (<https://www1.nseindia.com/>).

These 16 industries are metals, textiles, chemicals, construction, fertilizers& pesticides, cement & cement products, industrial manufacturing, automobile, consumer goods, IT, financial services, services, energy, pharma, telecom, media & entertainment. Based on the equity market return and volatility these sectors are categorized in three types as (a) Low Stressed (b) Medium Stressed (c) High Stressed.

Literature Review

There is rich literature (Mitton, 2002; Lemmon and Lins, 2003; Baek et al .2004) that draws attention to attributes of corporate governance and their influence on the performance of firms during the crisis. Erkens et al. (2012) proved that corporate governance had an important impact on firm performance during the crisis through influencing firms’ financing policies. Also, their findings show that firms with more independent boards and greater institutional ownership experienced worse stock returns during the crisis period.

Lucky and Minai (2012) and Little et al. (2011) studied the effect of individual determinant, external factor and firm characteristics on small firm performance during crisis. Prior research has also studied the relationship between financial leverage and firm performance (Jandik and Makhija, 2005). Jandik and Makhija (2005) examined the effects of debt and debt structure on corporate performance and found that the relation between corporate performance and leverage is negative.

Earnings estimates and other factors feeding into valuation estimates certainly have changed. For example, the coronavirus directly reduced economic activities in certain industries. The virus could also indirectly reduce the

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companies' outlook through macroeconomic conditions (e.g., higher unemployment rate, reduced spending, and the threat of widespread bankruptcies), further suppressing the stock price. Such economic effects, however, do not tell the whole story. Stock prices often decouple from underlying corporate fundamentals during market turmoil, with market psychology and liquidity crunches adding to the stress levels. Reactions to market stress can also seize up the financial plumbing, as firms desperate for cash rush to liquidate stocks, further distancing immediate stock prices from firms' underlying valuations.

Stress in Industries

Metal

<https://www.mckinsey.com/industries/metals-and-mining/our-insights/lessons-from-the-past-informing-the-mining-industrys-trajectory-to-the-next-normal#>
https://www.accenture.com/_acnmedia/PDF-121/Accenture-Navigating-Impact-COVID-19-Mining-Metals.pdf

Textiles

25% of textile mills and garment units may be closed, 25-50% drop in overall demand and the export may fall by 34.6%, several lakhs of people will be out of jobs in FY21 due to Covid-19 pandemic. Mills normally keep four months of stocks since February. With lack of buyers for yarn from overseas and inland are putting extra stress for paying interest against working capital. This spinning sector may turn into non-performing assets (NPAs).

Chemicals

<https://www.bdapartners.com/covid-19s-impact-on-indian-chemicals-sector/>

Construction

<https://home.kpmg/content/dam/kpmg/in/pdf/2020/05/covid-19-assessment-economic-impact-construction-sector.pdf?r#:~:text=As%20per%20KPMG%20in%20India,and%20employment%20in%20this%20sector.>
<https://www.businesswire.com/news/home/20200420005398/en/Evaluating-Impact-COVID-19-Demand-Construction-Equipment-India>
<https://www.thehindu.com/business/covid-19-pandemic-is-likely-to-reduce-investment-in-construction-related-projects-kpmg/article31546351.ece>
<https://home.kpmg/content/dam/kpmg/in/pdf/2020/05/covid-19-assessment-economic-impact-construction-sector.pdf?r#:~:text=As%20per%20KPMG%20in%20India,and%20employment%20in%20this%20sector.>

Fertilizers & Pesticides

Overdependence on China for importing ingredients to Industry production is hurting indeed. But Sharp decline of crude oil has reduced the input cost and a marginal impact of Covid-19 is positive for big companies in this industry. This leads to the expectation of margin improvement too.

Cement & Cement Products

<https://realty.economicstimes.indiatimes.com/news/allied-industries/cement-demand-to-decline-45-50-in-q1-fy21-due-to-covid-19-ind-ra/75063597>

<https://realty.economicstimes.indiatimes.com/news/allied-industries/coronavirus-hit-on-domestic-cement-demand-likely-to-be-transient/74741482>

<https://realty.economicstimes.indiatimes.com/news/allied-industries/cement-demand-in-india-to-reduce-by-10-15-in-fy21-crisil/75018504>

https://www.business-standard.com/article/economy-policy/india-s-cement-production-to-fall-25-30-in-fy21-as-covid-19-saps-demand-120052801201_1.html

<https://www.financialexpress.com/industry/covid-19-to-hit-cement-sector-in-near-term-say-experts/1911374/>

Industrial Manufacturing

<https://government.economicstimes.indiatimes.com/news/economy/how-covid-19-can-be-a-blessing-in-disguise-for-indias-manufacturing-sector/75426628>

<https://www.arcweb.com/impact-covid-19-industrial-markets>

<https://www.craftdrivenresearch.com/manufacturing-sector-post-covid/>

<https://thediplomat.com/2020/04/after-covid-19-manufacturing-indias-new-economic-potential/>

Media and Entertainment

<https://www.crisil.com/en/home/newsroom/press-releases/2020/05/pandemic-to-cut-media-and-entertainment-sector-topline-by-Rs-25000-crore-this-fiscal.html>

Automobile

Changes of Goods and Services Tax, shift to Shared Mobility, Axle-load reforms, the Bharat Stage-IV (BSIV) to Bharat Stage-VI (BS-VI) transition have already impacted this sector long back, presently due the Covid-19 a prolong truncation of demand is another added factor to illiquidity. This sector is dependent on migrant labour which may cause a slow revival of this sector.

Consumer Goods

There is a significant change in consumer behavior after Covid-19. Shrinking household income, health and hygiene are integral part of lifestyle; consumers prefer home delivery of packet products.

IT

Currency volatility, unable to travel for marketing events, productivity loss, and risk of potential rise in cyber security, cancellation and ramp down of existing projects, customer spending are important concerns in this market amid the work-from-home model.

Relation between FSI and Stock market index, VIX, foreign fund

<https://www.bloomberquint.com/business/india-insurers-boost-cash-stress-test-stocks-on-market-swings>

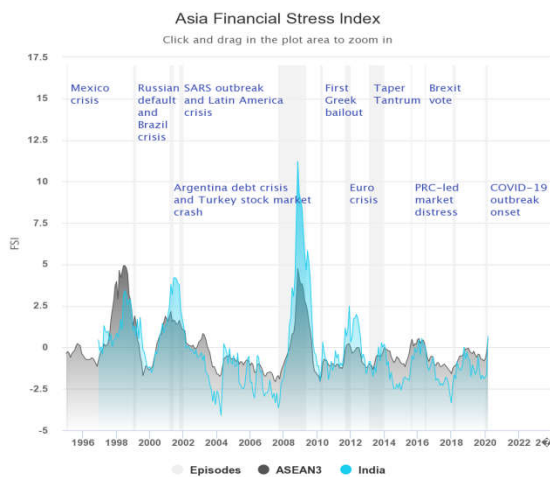
DATA AND METHODOLOGY

We have used daily price data of stocks, index, VIX, P/E of index and macro data of 100 plus firms. Macro data is used to build machine learning models. We have followed two steps to annotate low or high industries. The 16 industries are metals, textiles, chemicals, construction, fertilizers& pesticides,

cement & cement products, industrial manufacturing, automobile, consumer goods, IT, financial services, services, energy, pharma, telecom, media & entertainment included in this study. We followed consensus and exploratory exploration analysis for doing manual annotation.

Consensus Estimation

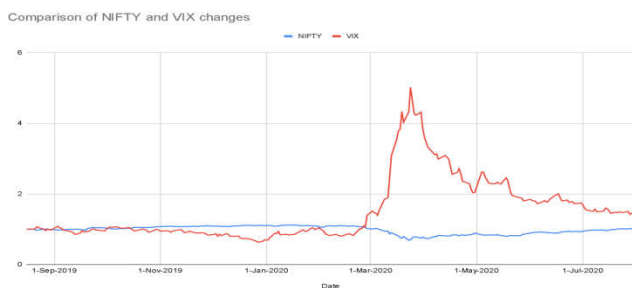
View of the UNCTAD is “Economy will go into recession... possible exception of India”. And based on the performance of industries and prolonged lockdown triggered the chance of earning disruption across all industries. We built a questionnaire and started a four months long research from 4th April 2020 #lockdown. We have a set of 5 questions here. We estimated the consensus profit drop and clustered affected industries through social media posting and questionnaires. Based on the consensus result we have now two categories of Industries (a) Low Stressed (b) High Stressed and the expected drop of profit by 31st June 2020 is 20%. The consideration of equity market return and volatility for this categorization is based on the methodology followed by Asia FSI (Figure 2). Financial stress indices (FSI) for emerging economies proposed by Balakrishnan *et al.* (2011).



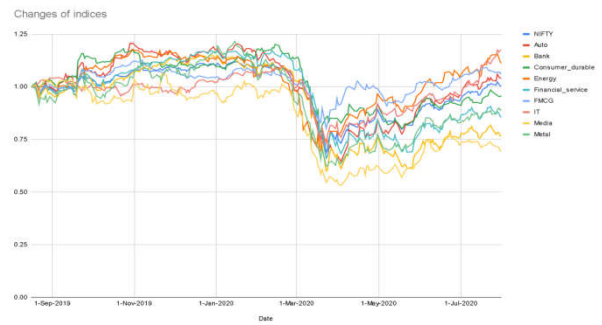
(Figure 2) Sources: ADB calculations using data from Bloomberg; CEIC; Haver Analytics; and International Monetary Fund. International Financial Statistics. <http://data.imf.org/IFS> (accessed April 2020), and methodology by Mercado and Park (2014).

Exploratory Data Analysis

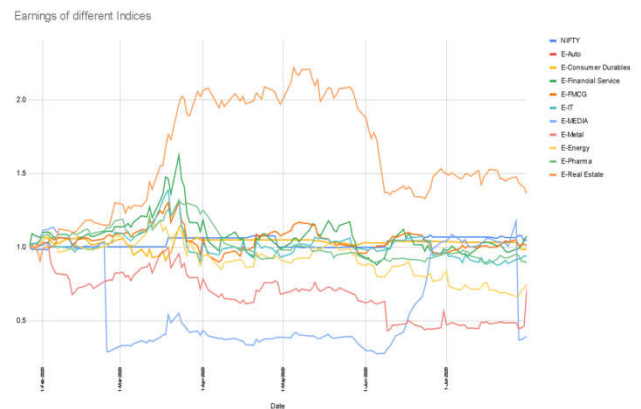
The relation between change of NIFTY and VIX



(Figure 3)Source: During the lockdown the sudden increase of VIX and continuing the above level along with decrease of index value (return) supports the relevance of methodology of stress estimation (<https://aric.adb.org/database/fsi>).



(Figure 4) Source: The price changes of the index suddenly dropped during the first lockdown period on 24th March 2020. The recovery of the price is different till June 31st 2020. (https://www1.nseindia.com/products/content/equities/indices/archieve_indices.htm)



(Figure 5)Source: Earning from different industries shows different volatility. FMCG, IT, Pharma, Consumer durables and few more industries have shown a stable earning line for 6months. (https://www1.nseindia.com/products/content/equities/indices/archieve_indices.htm)

Machine Learning Model

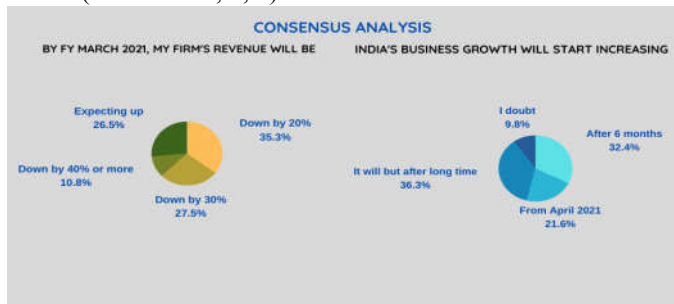
For finding out the feature importance Random Forest is used to find which ratios are important components to find stress classification. We have selected all sets of ratios related to stress from the Altman Z score. Variables used for analysis are as follows: Debt Ratio, Earning Ratio, Current Ratio, PATM, PAT, Inventory, Turnover, Total Liabilities, Total Assets, Gross Sales, Cash Flow from Operations, Free Cash flow, Exports - FOB Value, Imports - CIF Value, Capacity Utilized, VIX, Sectoral Index, stock price. For Classifying a company low or high stress SVM Model is used.

RESULTS AND CONCLUSION

Consensus Analysis

Industry performance after first phase of #lockdown based on NSE 100 stocks (graph). Only pharma showed a positive result (Annexure 1). After completion of the second phase of lockdown on 3rd May 2020, all the sectors bounced back and showed positive return, including pharma (Annexure 2). The analysis of the input received from the survey <https://bit.ly/3dN3VLw> shows firm’s revenue may not be

decreased more than 30% and growth will be visible by next 9 months(Annexure 3, 4, 5).



(Figure 6) Consensus Analysis

Exploratory Data Analysis

From Consensus and Exploratory Data analysis it has been shown that risk is increased among all the industries during the lockdown period. Except metal, textile, chemical, construction, manufacturing, consumer goods, the return is increased during the lockdown period.

Based on the consensus and exploratory data analysis the outcome helped to classify the stress of industries in two categories low and high. Low stress signifies the possibility of profit drop due to Covid lockdown is below 20% and high mean more than 20% profit drop. Analysis shows the investors and traders in the stock market (India) are optimistic amid consensus sector level revenue loss of 20% by June 2020.

Industry	Volatility Change during Lockdown from normal time	Return Change during Lockdown from normal time	Return Change during last week of July from lockdown time	Literature Review	Index Earning change	EDA- Perception	Stress Classification
Metals	-1	-1	1	6	-1	Negative	2
Textiles	1	-1	1	7	0	Negative	2
Chemicals	1	-1	1	4	0	Positive	1
Construction	1	-1	1	8	0	Negative	2
Fertilisers & pesticides	1	1	1	4	0	Positive	1
Cement & cement products	1	1	1	8	0	Negative	2
Industrial manufacturing	1	-1	1	9	0	Negative	2
Automobile	1	1	1	9	0	Negative	2
Consumer goods	1	-1	1	3	0	Positive	1
It	1	1	1	3	0	Positive	1
Financial services	1	1	1	5	0	Negative	2
Services	1	1	1	7	0	Negative	2
Energy	1	1	1	5	-1	Negative	2
Pharma	1	1	1	2	0	Positive	1
Telecom	1	1	1	1	0	Positive	1
Media & entertainment	1	1	-1	9	-1	Negative	2

(Figure 8) Manual annotation of industry stress from above consensus

12 features are important for model building (Figure 9). We have dropped the capacity Utilization for building our classification model. They are Total Assets (0.194706), Total Liabilities (0.131015), Gross Sales (0.122488), Debt Ratio (0.107771) Earnings Ratio (0.094285), PAT (0.074052), Current Ratio (0.065755), PAT margin (0.059085), Imports - CIF Value (0.047530), Inventory Turnover (0.044061), Free Cash flow (0.03409), Exports - FOB Value (0.025161) and Capacity Utilized (0.000000).

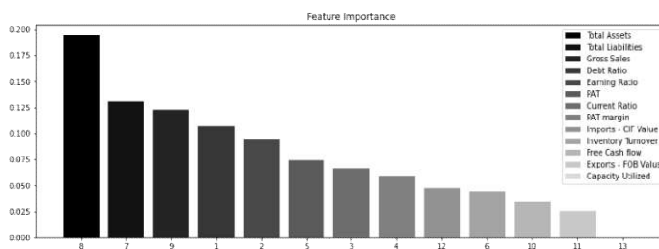


Figure 9 Feature Importance for the model

We have checked Logistic Regression, Random Forest and XG Boost for model accuracy testing. The output accuracy is considered as the base score of XG Boost for modelling. We found that Logistic Regression model (solver='newton-cg') with accuracy of 57%, Random Forest Classifier (n_estimators=1000,max_features=9)with71% and XGB Classifier(max_depth=5,learning_rate=0.05,n_estimators=100 0,objective='binary:logit', booster='gbtree', gamma=0,base_score=0.57) with 85%. The code is available at github []. The above model is developed based on these leaf distributions.

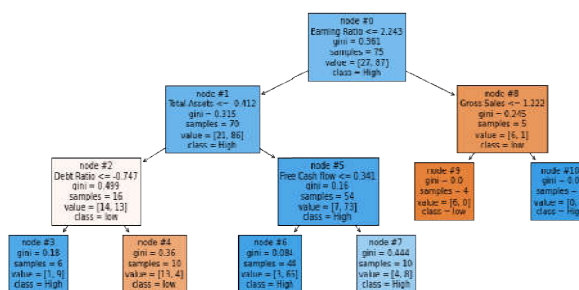


Figure 10

So the XGBoost model is most accurate (85%) to predict the low industry stress or high industry stress based on 12 features. Total assets, Total liabilities, Gross Sales, Debt Ratio and Earning Ratio are top 5 features to determine the stress of Industry.

Reference

Mitton, T., 2002.A Cross-Firm Analysis of the Impact of Corporate Governance on the East Asian Financial Crisis.*Journal of Financial Economics* 64, p.215-241.

Lemmon, M.L. and K.V. Lins, 2003. Ownership Structure, Corporate Governance, and Firm Value: Evidence from the East Asian Financial Crisis. *Journal of Finance* 58, p.1445-1468.

Baek, J., Kang, J., Park, K., 2004. Corporate governance and firm value: Evidence from the Korean financial crisis. *Journal of Financial Economics* 88, p.499-533.

Erkens, D. H., Hung, M. and Matos, P., 2012. Corporate Governance in the 2007-2008 Financial Crisis: Evidence from Financial Institutions Worldwide. *Journal of Corporate Finance* 18, p. 389-411.

Lucky, E. O. I. and Minai, M. S., 2012.Re-Investigating the Effect of Individual Determinant, External Factor and Firm Characteristics on Small Firm Performance during Economic Downturn. *African Journal of Business Management* 6, p. 229-237.

Little, P. L., Mortimer, J. W., Keene, M. A. and Henderson, L. R., 2011. Evaluating the Effect of Recession on Retail Firms' Strategy using DuPont Method: 2006-2009. *Journal of Finance and Accountancy* 7, p. 1-7

Jandik, T. and A.K. Makhija, 2005. Debt, Debt Structure and Corporate Performance after Unsuccessful Takeovers: Evidence from Targets that Remain Independent. *Journal of Corporate Finance* 11, p. 882-914.

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