CHANGES IN TAXONOMY- CASE OF INDIA BEFORE AND DURING COVID

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Abstract

This paper examines the changes in linkages in the Indian financial system using Principal component analysis and distance matrix. It also defines relationship between various market forces such as share market, exchange rate, precious metal, derivatives market, commodity market , financial institutions, etc. The share market and VIX was the dominant factor influencing the movements in the financial structure prior to the crises however, the metal market and exchange rate were the factors showing the maximum change in its working. Furthermore, we observe that during a recession, financial markets become more interconnected. A greater financial system integration was discovered to begin just before the recession. This research will benefit Individuals, institutions, regulators, and central bankers from the research findings by having a better understanding of market structure during economic instability, allowing for more efficient techniques to be deployed to reduce systemic risk.

  KEY WORDS – principal component analysis, taxonomy, financial structure, and covid crises

INTRODUCTION

The interrelationship between financial and economic development has been widely seen in the world economy. The scientific literature on the finance – economic development nexus has held an inconclusive explanation about the association between these variables. In 2020, the world faced a deadly spread of covid-19 pandemic. This research intends to study changes that happened in the Indian financial system when the world economy was shaken due to covid pandemic . It aims to examine the difference in functioning, dominance, increased/ decreased linkages, positive / negative effects on the economy using different phases of pre pandemic and   pandemic phase .

LITERATURE REVIEW

Measuring financial development in India: A PCA approach (Sanjaya Kumar LENKA , 2015), The study used time series data from 1980 to 2011 and 1990 to 2011 to measure country's financial sector development in terms of financial depth index (IFD), which can be used for analysis. An Application of Principal Component Analysis to Stock Portfolio Management (Yang, Libin,) 2015, The PCA can reduce the complexity of a stock portfolio by transforming the stocks into a new set of uncorrelated principal components that represent unco- related risk sources. (Figuerola-Ferretti and McCrorie, 2016, Klein, 2017), As a result, the dynamics of precious metal markets in the current global economic situation and their dynamic trends around times of market turmoil have attracted the special attention of many scholars . (Hillier et al., 2006, Baur and McDermott, 2010, Lucey and Li, 2015), Precious metals, which are considered safe investment assets, outperform traditional assets, such as stocks or bonds, especially in times of high uncertainty. Exchange Rate Volatility and Trade Flows - Some New Evidence (Peter Clark, Natalia Tamirisa, and Shang-Jin Wei, with Azim Sadikov, and Li Zeng), liberalization and cross border movements across nations had led to increase of exchange rate transactions

OBJECTIVE

The objectives of the study can be stated as:

[A]To study empirically existence of taxonomy in Indian financial Structure.

   (i) During january 2018- december 2019 [pre –pandemic period]

   (ii) During january 2020-October 2021 [during pandemic period]

[B] To investigate the structure and linkages of components of financial system

   (i) During january 2018- december 2019 [pre –pandemic period]

   (ii) During january 2020-October 2021 [during pandemic period]

RESEARCH METHODOLOGY

Return Calculation

The daily returns are calculated using daily closing prices for these indices . The daily return is calculated using the formula:-

$R_{it} = \{\log (CP_t) - \log (CP_{t-1})\} \times 100$

Where,

R_{it} is return for the current day

CP_t is current day's closing price,

And CP_{t-1} refers to previous day's closing price.

Thus , in all 7 series with daily observations was generated for the period pre-pandemic period and , another 7 series with daily observations were generated for during pandemic period.

The descriptive statistics for the all 7 series were studied for pre-pandemic period and during pandemic period. There after Principal Component Analysis is used to reduce the variables to principal components. Thereafter , Kaiser- Meyer- Olkin   Test and Bartlett Test of Sphericity , Pearson's Correlation Coefficient and distance matrix are calculated.

As done in Mantegna (1999), a revised unit for distance is calculated using the Pearson Correlation:

$$d_{cor}(i,j) = \sqrt{2(1-\rho_{ij})}$$

Where,

ρ_{ij} = Pearson's Correlation Coefficient between indexes i and j

$d_{cor}(i, j)$ = Distance between two indexes achieved by Eq 2

Eq 2 gives an n*n matrix of distances .The distance dcor (i, j) now varies from 0 to 2. This distance is used implies that greater the correlation, lesser the distance between those two components.

RESULTS AND DISCUSSIONS

The descriptive statistics analysis reveals that the performances, in terms of mean returns, and risk associated in terms of standard deviation, of all variables under study varied greatly in pre and during crisis period. Stock market (Sensex) and LowVIX have positive mean returns in both periods but increased returns when in crisis. Also, standard deviation when facing the crisis increases for both these sectors this shows the decrease in volatility during crises period.

An interesting observation is the behavior of mean returns of commodities market(Oil and gas) , Precious Metals market and Real estate market (Realty index) which are negative in the pre-pandemic zone crisis period and become positive when the global economy is facing Pandemic crisis. It implies increased faith of investors in these markets in times of turmoil. The Bankex and Exchange rate on the other hand represented gives higher returns in pre crisis period in comparison to the during crisis period .

The Principal Component Analysis was applied, separately, for the data spanning from January 2018-December 2019 , defined as pre-pandemic crisis period and for January 2020-October 2021 , defined as during pandemic crisis period .Varimax rotation was applied for initial analysis. As can be seen from Figure 3 and figure 4 the principal component analysis has found the underlying clustering pattern in Indian financial structure. The seven variables were reduced into two Components, each having variables with higher degree of affinity in terms of Eigen values.

Table 1 and Table 2 displays that in the period preceding Pandemic crisis, component 1 explained 59.295% of variance and was loaded with 5 variables and Component 2 explained 14.401 and was loaded with 2 variables . During the period of Pandemic crisis, component 1 explained 65.725% of variance and was loaded with 5 variables and component 2 explained 6.257% and was loaded with 2 variables .The variables in component 1and component 2 were found to be similar in pre-pandemic crisis period but different during the pandemic crisis period   .The difference between the variance explained by individually by the components ,in the two periods, differed marginally . The cumulative variance

explained by the two components in the pre pandemic crisis period and during the pandemic crisis period was 73.695% and 71.982%, respectively.

Rotated Component Matrix

Table:1				Table:2		
Pre-Pandemic Period : January 2018- December 2019 (Expansion Phase)				**Matrix During Pandemic Crisis Period :** January 2020-October 2021 (Recession Phase)		
	Component 1	Component 2			Component 1	Component 2
Sensex	0.94	-0.021		Sensex	0.207	0.05
LowVIX	0.893	0.005		Oilandgas	0.19	0.894
Bankex	0.878	-0.044		Bankex	0.191	0.878
Reality	0.766	-0.105		Reality	0.178	0.874
Metals	0.765	0.012		LowVIX	0.194	0.831
Oilandgas	0.726	0.013		Metals	0.181	0.82
ExchangeRate	-0.026	0.997		ExchangeRate	-0.01	-0.047
Eigen values	4.157	1.002		Eigen values	4.601	0.998
Percentage Variance Explained	59.295	14.401		Percentage Variance Explained	65.725	6.257
Cumulative Variance Explained	73.695			Cumulative Variance Explained	71.982	

Kaiser- Meyer- Olkin Test and Bartlett Test of Sphericity

| **Table 3 :** Kaiser- Meyer- Olkin and Bartlett's Test		**Pre Pandemic Period:** January 2018-December 2019 (Expansion Phase)	**During Pandemic Crisis Period :** January 2020-October 2021 (Recession Phase)
Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.828	.841
Bartlett's Test of Sphericity	Sig.	.000	.000

As can be observed from table 3 that KMO measure for both period is approximately more than 0.8 which ensures adequacy of sample. The Bartlett's test of sphericity is significant. That is, its associated probability is less than 0.05 ,which means that the correlation matrix is not an identity matrix .

Pre Pandemic Period:
January 2018- December2019 (Expansion Phase)

| **Direction Matrix** Sensex	Sensex	Oilandgas	Bankex	Reality	LowVIX	Metals	Exchange Rate
Oilandgas	0	0.52	0.18	0.53	0.16	0.53	1.48
Bankex	0.52	0	0.66	0.78	0.62	0.68	1.45
Reality	0.18	0.66	0	0.52	0.37	0.61	1.49
LowVIX	0.53	0.78	0.52	0	0.53	0.64	1.53
Metals	0.16	0.62	0.37	0.53	0	0.56	1.44
Exchange Rate	0.53	0.68	0.61	0.64	0.56	0	1.44

Figure 1
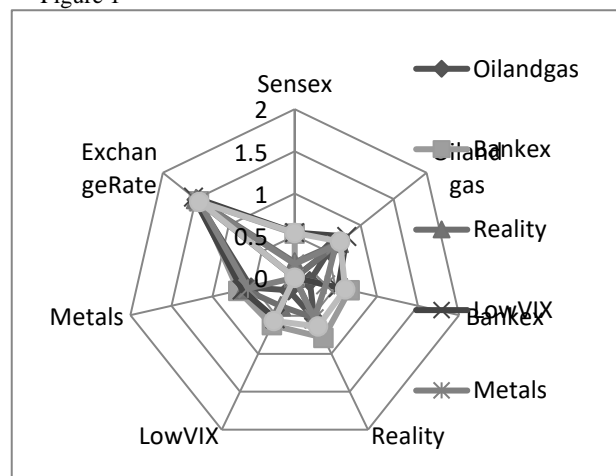
Figure 1

The distance matrix helps us to know the variable distances between 2 factors. As shown in the figure: 1 , there is an interlinked direction between various variable indicating distance between them with the help of correlation matrices. Here exchange rate has the maximum distance from other variables, leading to major relation to correlations between factors. In the figure: 2, there is an interlinked direction between various variable indicating distance between them with the help of correlation matrices. Here exchange rate has the maximum distance from other variables, leading to major relation to correlations between factors. Furthermore when compared to pre-pandemic period the distances have slightly decreased and variables have come closure to each other.

During Pandemic Crisis Period:

January 2020-March 2022 (Recession Phase)

Direction Matrix							
Sensex	Sensex	Oilandgas	Bankex	Reality	LowVIX	Metals	Exchange Rate
Oilandgas	0	0.30	0.12	0.41	0.21	0.41	1.46
Bankex	0.30	0	0.48	0.51	0.31	0.38	1.46
Reality	0.11	0.48	0	0.45	0.42	0.51	1.46
LowVIX	0.42	0.51	0.45	0	0.45	0.52	1.45
Metals	0.21	0.31	0.42	0.45	0	0.45	1.45
Exchange Rate	0.41	0.38	0.51	0.52	0.45	0	1.46
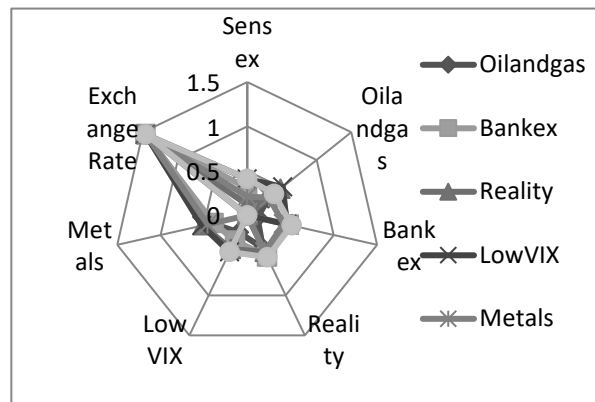
CONCLUSION AND IMPLICATIONS

In view of the covid-19 epidemic, this study attempted to determine the amount of integration of components of the Indian financial system. The study's findings are positive. The findings of principal component analysis shed insight on the differences in structure, connection, and dominance of various financial structure components. Variables were chosen to represent the major components of the Indian financial structure. The variables used to represent the equities market, derivatives market, foreign currency market, real estate market, commodities market, precious metal markets, and financial institutions include Sensex, LowVIX, Foreign exchange rate, Realty Index, Oil prices, Gold prices, and Bankex. The main component analysis results neatly simplified the 7 components of the Indian financial system into two groups / components based on their similarities. This confirmed the presence of taxonomy in the Indian financial system.On a macro level, the findings provide policymakers an inventive and fertile ground for creating more realistic laws with the ability to change them in times of crisis when the behaviour of financial system components may differ.

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