

Sectoral Drawdown Synchronization and Recovery Dispersion During Market-Stress Episodes: Evidence from India

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ABSTRACT

This study examines whether market-wide stress increases synchronization across Indian equity sectors and whether the severity of sectoral drawdowns is associated with subsequent recovery duration. Using daily data for six major NIFTY sectoral indices and India VIX from January 2016 to December 2025, the analysis distinguishes between broadly elevated market stress and major stress episodes. Sectoral synchronization is assessed using pairwise return correlations and 20-day rolling correlations, while peak-to-trough drawdowns and recovery durations are measured for identified major stress episodes. The results show that average pairwise sectoral correlation increases from 0.363 during non-high-stress periods to 0.591 during high-stress periods, representing an increase of approximately 62.6%. Rolling sectoral synchronization is also positively associated with India VIX, and this relationship remains statistically significant using Newey–West standard errors. Although sectors display considerable variation in observed drawdown severity and recovery duration, cross-sector differences are not statistically significant. In contrast, drawdown magnitude is strongly and positively associated with recovery duration (Spearman's $\rho = 0.722$, $p < 0.001$), with the relationship remaining robust after excluding recoveries interrupted by subsequent stress episodes. The findings indicate that market stress reduces the diversification benefits available across sectors by increasing common movement, while the depth of sectoral losses provides important information about the time subsequently required for recovery. By jointly examining synchronization, drawdown severity and recovery duration, the study provides an integrated perspective on sectoral resilience during market-stress episodes in the Indian equity market.

Key Words: Market stress; sectoral synchronization; drawdown; recovery duration; India VIX; Indian equity market.

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INTRODUCTION

Sectoral diversification is one of the basic ways investors attempt to reduce equity-market risk. The underlying logic is that industries respond differently to economic conditions. Banks are particularly sensitive to interest rates and credit conditions, technology firms are exposed to global demand and exchange-rate movements, metals respond strongly to commodity cycles, while automobiles, pharmaceuticals and consumer-goods companies face different combinations of domestic and external influences. As long as these differences remain important, losses in one part of the market may be partly offset by more favourable performance elsewhere. The effectiveness of this protection, however, depends on sectors continuing to behave differently when market conditions deteriorate.

Periods of severe market stress can weaken this distinction. Rising uncertainty, changing risk perceptions and broad portfolio adjustments can cause investors to respond simultaneously across different parts of the market. As common market forces become more influential, correlations can increase and apparently diversified sectors can begin moving in the same direction. The distinction between normal interdependence and unusually strong comovement during turbulent periods has long been important in the financial-contagion literature. (Forbes & Rigobon, 2002) demonstrate that cross-market relationships can change substantially during periods of high volatility, while also cautioning that an observed increase in correlation should not automatically be interpreted as contagion.

This issue has practical consequences because diversification is most valuable when markets are falling. If sectoral correlations increase precisely during periods of elevated stress, the protection suggested by normal-period correlations may weaken when investors need it most. The COVID-19 market disruption provides a clear example of the consequences of a common shock. (Rao et al., 2021) document substantial vulnerability and contagious effects in Indian financial markets during the pandemic, while international evidence shows pronounced differences in sectoral responses to the March 2020 market collapse (Mazur et al., 2021) Such episodes demonstrate that market stress can simultaneously produce widespread losses and considerable differences in the severity of those losses.

Correlation alone, however, does not describe the complete experience of an investor during a stressful market episode. Once prices begin falling, the magnitude of the decline becomes equally important. A sector that falls 10% from its preceding peak faces a different risk experience from one that falls 40%, even if their daily returns are highly correlated during the decline. Drawdown provides a direct way of capturing this dimension because it measures the loss from a previous peak to a subsequent trough. The drawdown literature emphasises that this peak-to-trough perspective contains information about downside risk that is not fully represented by conventional volatility measures (Geboers et al., 2023) Yet the story does not end at the trough. Two sectors can experience similar drawdowns and still impose very different consequences on investors if one quickly regains its previous level while the other remains below its pre-stress peak for an extended period. Recovery duration therefore adds a time dimension to downside risk. From an investor's perspective, the relevant question is not only how much value is lost during stress, but also how long it takes for that loss to be recovered. The combination of synchronization, drawdown and recovery consequently provides a broader view of sectoral resilience than any of these dimensions considered separately.

These issues are particularly relevant for India. The Indian equity market contains sectors with markedly different economic exposures, yet all are simultaneously affected by changes in aggregate

uncertainty and investor risk perception. India VIX provides an observable market-based indicator of this uncertainty, allowing stressful market conditions to be identified without restricting the analysis to a single predetermined crisis. Existing Indian studies provide substantial evidence of return and volatility transmission across sectors and show that sectoral relationships vary through time. More recent evidence also confirms considerable return and volatility interactions among Indian sectoral indices (Dhingra et al., 2024). Nevertheless, much of this literature concentrates on volatility spillovers, connectedness or particular crisis periods.

A related limitation is that synchronization and post-shock performance are often treated as separate questions. Evidence that sectors become more connected during turbulent periods does not reveal how deeply individual sectors fall, and evidence on crisis-period returns does not necessarily show how long sectors require to recover. Consequently, comparatively less attention has been given to following the complete sequence of a market-stress episode: whether sectors first become more synchronized, how large their subsequent peak-to-trough losses are, and whether those losses are followed by similar or substantially different recovery paths in the Indian market.

This study addresses this issue by examining six major Indian sectoral indices—NIFTY Bank, NIFTY IT, NIFTY Pharma, NIFTY FMCG, NIFTY Auto and NIFTY Metal—over the period from 1 January 2016 to 31 December 2025. India VIX is used as the measure of market-wide stress. The analysis distinguishes between broadly elevated daily stress and more extreme stress episodes, allowing synchronization and episode-specific downside outcomes to be examined within a common framework. Sectoral synchronization is assessed using pairwise return correlations and a 20-day rolling synchronization measure, while major stress episodes are used to evaluate sector-specific drawdowns and subsequent recovery durations.

The study contributes to the literature in three related ways. First, it examines whether sectoral synchronization systematically strengthens as market-wide stress increases, rather than limiting the analysis to a single crisis event. Second, it links market stress to episode-specific drawdown severity across economically distinct Indian sectors. Third, it extends the analysis beyond the market trough by examining recovery duration and the relationship between the depth of a drawdown and the time subsequently required to recover. This integrated perspective distinguishes between moving together during stress, suffering similar losses and recovering at similar speeds—three outcomes that need not occur simultaneously.

The empirical evidence reveals a clear pattern. Average pairwise sectoral correlation increases substantially under elevated market stress, and rolling synchronization is positively associated with India VIX. At the same time, sectors display visible differences in drawdown severity and recovery duration across major stress episodes, although these sector-level differences are not statistically significant when considered across the full set of episodes. A considerably stronger regularity emerges between loss severity and subsequent recovery: deeper sectoral drawdowns are associated with longer recovery periods. The findings therefore suggest that market stress has two related consequences for sectoral risk. Sectors become more synchronized as market-wide stress rises, reducing diversification opportunities, while the eventual path back to pre-stress levels remains dependent on the severity of the loss experienced during the stressful episode.

These findings have implications for both investors and risk managers. Diversification decisions based only on normal-period sector correlations may understate portfolio vulnerability if correlations

rise during stressed conditions. Similarly, evaluating an episode only through its maximum loss ignores the time for which capital may remain below its previous peak. Considering synchronization, drawdown severity and recovery duration together therefore provides a more complete assessment of sectoral resilience during periods of elevated market stress.

Against this background, the primary objective of this study is to examine whether market-wide stress is associated with stronger synchronization among Indian sectoral indices and to assess the drawdown and recovery behaviour of these sectors during major market-stress episodes.

Specifically, the study addresses four questions:

- (1) Does sectoral return synchronization increase during periods of elevated market stress?
- (2) Do drawdown magnitudes differ across Indian sectoral indices during major stress episodes?
- (3) Do recovery durations differ across sectors following these episodes?
- (4) Are deeper sectoral drawdowns associated with longer recovery durations?

LITERATURE REVIEW

Market Stress and Cross-Sector Co-movement:

Diversification across sectors rests on a simple premise: different industries are exposed to different economic forces and therefore need not move together at all times. A banking index may respond strongly to interest-rate conditions, while technology, pharmaceuticals, consumer goods, automobiles and metals respond to different combinations of domestic and global factors. When these differences dominate, spreading investments across sectors can reduce portfolio risk. The problem arises when market-wide uncertainty becomes sufficiently strong to overwhelm these sector-specific influences.

This issue becomes particularly important during periods of financial stress. As uncertainty rises, investors may respond simultaneously to common information, changes in risk appetite and deteriorating market expectations. Price movements that were previously driven by sector-specific factors can consequently become increasingly dominated by the same market-wide shock. From a portfolio perspective, this means that correlations may rise precisely when diversification is most needed.

The broader contagion literature provides an important foundation for understanding this behaviour. (Forbes & Rigobon, 2002) show that measured cross-market correlations can change considerably during turbulent periods, while also demonstrating that higher correlations during crises should not automatically be interpreted as contagion because correlation estimates themselves are affected by changes in market volatility. Their contribution therefore establishes an important distinction between ordinary interdependence and an exceptional strengthening of market relationships during periods of instability.

Subsequent research developed more dynamic approaches to examining these relationships. (Engle, 2002) introduced the dynamic conditional correlation framework, allowing correlations between financial returns to vary through time rather than assuming that relationships remain constant. (Diebold & Yilmaz, 2012) further shifted attention towards the transmission of shocks across financial assets by developing measures of directional volatility spillovers. (Diebold & Yılmaz, 2014)

extended this approach through a network interpretation of financial connectedness, providing a framework for examining how strongly different parts of a financial system become linked.

These developments are important because they change the way sectoral diversification is viewed. Correlations observed during relatively calm periods cannot necessarily be assumed to persist when market conditions deteriorate. (James et al., 2022) for example, show that correlation structures and diversification benefits vary across and within equity sectors. Their evidence reinforces the idea that collective market behaviour can strengthen during periods of instability, reducing the protection normally expected from diversification across sectors.

The same issue is particularly relevant in an emerging market such as India, where sectors differ substantially in their exposure to domestic demand, global conditions, commodity prices, financial conditions and investor sentiment. Indian evidence confirms that relationships among sectors are not stable through time. (Chatziantoniou et al., 2022) document substantial dynamic connectedness across Indian stock-market sectors and show that the strength and direction of sectoral spillovers change over time. Their findings suggest that major economic and financial disturbances can alter the degree to which Indian sectors behave as separate components of the equity market.

Evidence based specifically on volatility transmission reaches a similar conclusion. Studies of Indian sectoral indices identify significant spillovers across sectors, indicating that shocks need not remain confined to the industry in which they initially appear. More recent evidence from (Dhingra et al., 2024) further demonstrates return and volatility interactions across a broad set of Indian sectoral indices. Taken together, these studies suggest that the Indian equity market contains an important common component through which disturbances can spread across sector boundaries.

The COVID-19 market disruption provides a particularly visible example of this mechanism. (Rao et al., 2021) document the vulnerability and contagious effects experienced by Indian financial markets during the pandemic. (Sahoo & Kumar, 2023) similarly report substantial volatility spillovers and high time-varying correlations among Indian sectoral indices during the COVID-19 period. Their findings indicate that sectoral diversification opportunities became more limited when market conditions were severely disrupted. Evidence from other markets reaches comparable conclusions. (Mazur et al., 2021) document pronounced differences in sectoral performance during the March 2020 market collapse, while (Ahmad et al., 2021) show that extreme events such as COVID-19 generated heterogeneous effects across sectors in major developed equity markets.

A common message therefore emerges from this literature. Sectors may retain distinct behaviour during ordinary market conditions, but common market forces become increasingly important when uncertainty and financial stress intensify. Existing studies have established this primarily through conditional correlations, volatility spillovers, connectedness networks and crisis-specific analyses. What remains less clear is whether the synchronization of broad Indian sectoral returns increases systematically with a directly observable measure of market-wide stress rather than only during a predetermined crisis period.

This distinction motivates the first part of the present study. Instead of treating a single historical crisis as the sole definition of stress, India VIX is used to identify elevated market-stress conditions throughout 2016–2025. Sectoral synchronization is then examined both across high- and lower-stress regimes and continuously through rolling pairwise correlations. This approach allows the analysis to move from the broader question of whether sectors are interconnected to the more specific question

of whether their movements become systematically more synchronized as market-wide stress increases.

Sectoral Connectedness and Market Stress in India:

The possibility that sectors become more closely connected during periods of market stress is particularly relevant in the Indian equity market. India combines industries that differ considerably in their sensitivity to domestic consumption, interest rates, global demand, commodity prices and external financial conditions. Such differences can create diversification opportunities during normal market conditions. However, when a sufficiently strong market-wide shock occurs, these sector-specific influences may be overshadowed by common uncertainty, causing disturbances to spread more widely across the market.

Early Indian evidence shows that the transmission of shocks across sectors is neither uniform nor constant over time. (Chakrabarty et al., 2015) examine news and volatility transmission across nine BSE sectoral indices and find that volatility interactions vary in both magnitude and direction across different investment horizons. Their results indicate that sectoral relationships depend partly on the time scale over which investors operate. This is important for diversification because a relationship observed over a short horizon may differ substantially from the relationship faced by longer-term investors.

The importance of time variation becomes even clearer when sectoral relationships are examined dynamically. (Chatziantoniou et al., 2022) show that connectedness among Indian stock-market sectors changes considerably over time and becomes particularly strong around periods of major economic and financial disruption. They identify heightened connectedness during episodes including the global financial crisis, the market disruption associated with high inflation in 2011, the 2014 national elections and the 2016 demonetization period. Their evidence therefore suggests that sectoral connectedness in India is closely related to changing market conditions rather than representing a stable characteristic of the market.

An important implication is that sectors do not play identical roles in the transmission of market disturbances. (Chatziantoniou et al., 2022) identify differences between sectors acting as net transmitters and those acting as net receivers of shocks. This means that market-wide connectedness can arise through an underlying network in which disturbances originating in some sectors are transmitted to others. Consequently, observing individual sector performance in isolation may provide an incomplete picture of market risk during turbulent periods.

The COVID-19 shock provides a more extreme illustration of this process. (Sahoo & Kumar, 2023) examine volatility spillovers among Indian sectoral indices during the pandemic and report substantial inter-sectoral relationships and time-varying conditional correlations. Their findings suggest that diversification opportunities across Indian sectors became more restricted during the crisis. This is consistent with the broader argument that market-wide disturbances can increase common movement across sectors precisely when investors seek protection through diversification.

Recent evidence further confirms the persistence of sectoral interactions. Using 16 Indian sectoral indices, (Dhingra et al., 2024) examine return spillovers and volatility dynamics and document considerable interconnectedness across sectors. Their findings also reveal differences in sectoral risk, with some sectors displaying greater vulnerability while others offer stronger diversification

potential. This reinforces the view that sectoral risk has two dimensions: the individual behaviour of a sector and its relationship with the rest of the market.

Taken together, Indian evidence shows a gradual progression in the understanding of sectoral relationships. Earlier studies established that volatility can move between sectors and that these interactions vary across investment horizons. Later connectedness studies demonstrated that the strength of these relationships changes through time, while crisis-period research showed that severe market disturbances can substantially restrict sectoral diversification. The literature therefore provides strong grounds for expecting sectoral dependence to strengthen when market-wide uncertainty rises.

However, much of the existing Indian evidence measures these relationships using volatility-spillover models, dynamic conditional correlations or connectedness frameworks. These approaches provide valuable information about the transmission of shocks, but they do not directly answer a simpler portfolio question: do broad Indian sectors become more synchronized as an observable measure of market-wide stress increases? Examining sectoral return correlations under different India VIX conditions provides a complementary way of addressing this question.

This leads naturally to a second issue. Greater synchronization during stress becomes particularly important when the common movement is downward. If several sectors decline together, the immediate concern shifts from correlation to the severity of the losses experienced by investors. The literature on sectoral connectedness must therefore be linked to the concept of drawdown, which captures how far an investment falls from its previous peak and provides a direct measure of the downside experienced during market-stress episodes.

Drawdown Severity and Downside Risk:

Greater synchronization becomes particularly important when common sectoral movement occurs during a market decline. Correlation and connectedness indicate whether sectors move together, but they do not directly reveal the magnitude of the loss experienced by an investor. Two sectors can exhibit similar return correlations during a stressful period while experiencing substantially different declines from their preceding peaks. This distinction makes drawdown an important complementary measure of market risk.

Drawdown measures the decline in the value of an asset or portfolio from a previous peak to a subsequent trough. Unlike conventional volatility measures, which summarise the dispersion of returns, drawdown focuses directly on the cumulative downside experienced over a particular market path. (Geboers et al., 2023) emphasise that drawdown-based measures provide information about downside risk that is relevant for investment and risk-management decisions. This perspective is particularly useful during market-stress episodes because investors are concerned not only with the variability of daily returns but also with how much value is lost before market conditions begin to improve.

The distinction between volatility and drawdown is important because large daily fluctuations do not necessarily translate into identical cumulative losses. A sector may experience high volatility while remaining relatively close to its previous peak, whereas another may undergo a persistent sequence of negative returns that produces a considerably deeper drawdown. Drawdown therefore provides a

path-dependent measure of downside exposure and complements the information contained in return volatility and correlation.

The importance of downside severity becomes especially visible during major market disruptions. (Mazur et al., 2021) document substantial differences in sectoral performance during the March 2020 stock-market collapse, showing that a common market shock can generate markedly different outcomes across industries. Similarly, (Ahmad et al., 2021) report heterogeneous sectoral responses to the COVID-19 shock across major developed equity markets. Such evidence suggests that increasing market-wide stress does not necessarily impose losses of equal magnitude across sectors, even when a common disturbance affects the broader market.

Indian evidence points to a similar sensitivity of sectoral performance to major disturbances. (Rao et al., 2021) document substantial vulnerability in Indian financial markets during the COVID-19 period, while (Anoop et al., 2018) show that the effects of the 2016 demonetisation episode varied across Indian stock-market sectors. Together with the evidence on time-varying sectoral connectedness discussed earlier, these findings indicate that common market disturbances can affect sectors simultaneously without necessarily producing uniform outcomes.

Drawdown analysis therefore extends the study of market stress beyond the question of whether sectors become more closely connected. If correlations increase during periods of elevated uncertainty, investors may face greater exposure to common market movements. The economic significance of this exposure, however, also depends on the depth of the resulting losses. Measuring sector-specific peak-to-trough declines during major stress episodes makes it possible to determine whether sectors exposed to the same broad market disturbance experience comparable or substantially different downside outcomes.

The severity of a drawdown is nevertheless only one part of the investor's experience. A substantial decline that is quickly reversed may have different consequences from a similar decline followed by a prolonged period below the previous peak. Assessing sectoral resilience therefore requires the analysis to continue beyond the trough and consider the time required for each sector to recover its pre-stress level.

Recovery Dynamics Following Market Stress:

The market trough marks the maximum loss experienced during a drawdown, but it does not mark the end of the consequences of a stress episode. Once a sector reaches its trough, investors remain exposed to the loss until the index returns to its previous peak. Recovery duration therefore introduces a time dimension to downside risk by measuring how long the effects of a market decline persist.

This distinction matters because drawdowns of similar magnitude need not be followed by similar recovery paths. The speed of recovery can depend on the nature of the initial shock, subsequent market conditions and differences in the economic exposures of individual sectors. Evidence from major market disruptions demonstrates that sectors can respond differently to the same aggregate event. During the COVID-19 shock, for example, (Mazur et al., 2021) document substantial heterogeneity in sectoral market performance, while (Ahmad et al., 2021) show that the effects of the pandemic differed considerably across industries and markets. These differences suggest that sectoral resilience cannot be assessed solely from the size of the initial decline.

The same reasoning is relevant to India, where sectoral indices represent industries with substantially different economic characteristics. Evidence of time-varying connectedness among Indian sectors (Chatziantoniou et al., 2022) and heterogeneous return and volatility dynamics (Dhingra et al., 2024) indicates that sectors need not respond identically as market conditions change. Although stronger connectedness may cause sectors to move together during the initial phase of market stress, their subsequent trajectories can diverge as sector-specific fundamentals regain importance.

Recovery duration consequently provides information that is not contained in contemporaneous correlation or maximum drawdown alone. From an investment perspective, the length of time required to regain a previous peak can influence capital allocation, portfolio rebalancing and the practical cost of remaining invested following a severe decline. A prolonged recovery can leave capital below its previous value for an extended period even after immediate market volatility has subsided.

An additional question concerns whether the depth of the initial drawdown is related to the subsequent recovery period. A deeper decline creates a larger distance between the trough and the previous peak and may therefore require a longer recovery, although the relationship need not be proportional. Recovery depends on the sequence of subsequent returns rather than simply reversing the percentage decline mechanically. The drawdown literature emphasises the importance of considering the path and persistence of losses rather than relying exclusively on conventional return-based measures (Geboers et al., 2023).

This relationship is particularly relevant when comparing sectors exposed to the same market-wide stress episode. If sectors become synchronized during the initial decline but differ in drawdown depth and subsequent recovery time, stress-period comovement does not imply identical resilience. Examining recovery duration alongside drawdown severity therefore makes it possible to distinguish between sectors that merely fall together and sectors that experience similar longer-term consequences.

Taken together, the literature suggests that market stress should be considered as a process extending beyond contemporaneous return movements. The first stage concerns whether common market uncertainty increases synchronization across sectors. The second concerns the severity of the losses generated during major stress episodes, while the third concerns the time required to recover those losses. Bringing these dimensions together provides the basis for examining sectoral resilience more comprehensively and leads directly to the research gap and hypotheses developed in the following section.

Research Gap and Hypotheses

The literature provides substantial evidence that relationships among equity sectors are not constant over time. During periods of elevated uncertainty, common market forces can become more influential, increasing correlations and strengthening the transmission of shocks across sectors. Studies of the Indian equity market similarly document time-varying sectoral connectedness, return and volatility spillovers, and stronger inter-sector relationships during periods of market disruption. The broader literature also shows that stressful market episodes can generate substantial sectoral losses and weaken the diversification benefits normally associated with investing across industries.

Despite these advances, three aspects of sectoral behaviour are generally examined separately. First, much of the existing Indian literature focuses on volatility spillovers, dynamic connectedness or specific crisis periods rather than directly examining whether sectoral return synchronization changes systematically with an observable measure of market-wide stress. Second, evidence on sectoral performance during stressful periods commonly concentrates on returns or volatility, while the peak-to-trough loss experienced during a stress episode receives comparatively less attention. Third, even when substantial sectoral losses are documented, the subsequent time required for sectors to regain their pre-stress levels is rarely considered jointly with the severity of the preceding drawdown.

These distinctions are important because synchronization, drawdown severity and recovery duration represent different dimensions of market risk. Sectors may become highly synchronized during a market decline without experiencing identical peak-to-trough losses. Similarly, sectors experiencing comparable drawdowns may require very different lengths of time to recover. Examining only one of these dimensions can therefore provide an incomplete picture of sectoral resilience during market stress.

The present study addresses this gap by examining the sequence of sectoral behaviour surrounding market-stress episodes in India. India VIX is used to identify changing market-wide stress conditions, while pairwise correlations and rolling synchronization capture the extent to which sectoral returns move together. Major stress episodes are subsequently used to measure sector-specific peak-to-trough drawdowns and the number of trading days required to regain pre-stress peak levels. This framework therefore connects the common movement of sectors during stress with both the severity and persistence of the losses that follow.

Based on the theoretical arguments and empirical evidence developed in the preceding literature, the following hypotheses are proposed:

H1: Sectoral return synchronization is higher during high-market-stress periods than during non-high-stress periods.

The strengthening of common market forces during periods of uncertainty suggests that sector-specific influences become relatively less important as aggregate stress increases. Sectoral correlations are therefore expected to be higher under elevated market-stress conditions.

H2: Drawdown magnitude differs across Indian sectoral indices during major market-stress episodes.

Because sectors differ in their economic exposures, sensitivity to financial conditions and responses to common shocks, the severity of peak-to-trough losses is expected to vary across sectors during major stress episodes.

H3: Recovery duration differs across Indian sectoral indices following major market-stress episodes.

Differences in sectoral fundamentals and sensitivity to economic conditions may continue after the immediate market decline. Consequently, sectors are expected to differ in the number of trading days required to regain their respective pre-stress peak levels.

H4: Larger sectoral drawdowns are associated with longer recovery durations.

A deeper decline creates a greater distance between the market trough and the pre-stress peak. All else equal, sectors experiencing more severe drawdowns are therefore expected to require longer periods to return to their previous peak levels.

Taken together, these hypotheses allow the study to examine sectoral resilience as a sequence rather than as a single market outcome: whether sectors become more synchronized when market stress rises, whether they experience different levels of downside severity, whether their recovery periods differ, and whether the depth of the initial loss is systematically related to the time required for recovery.

DATA AND METHODOLOGY

Data and Sample:

The study examines sectoral market behaviour in India from 1 January 2016 to 31 December 2025. The sample includes six major NIFTY sectoral indices: NIFTY Bank, NIFTY IT, NIFTY Pharma, NIFTY FMCG, NIFTY Auto, and NIFTY Metal. These indices represent sectors with different economic characteristics and therefore provide a useful setting for examining whether market-wide stress leads to greater synchronization in sectoral movements and whether sectors differ in their drawdown and recovery patterns.

Daily closing index levels are used to measure sector performance. India VIX is used as the indicator of market-wide stress, as it reflects expected near-term volatility in the Indian equity market. The sectoral indices and India VIX are aligned by trading date, resulting in a final dataset of 2,452 daily observations. No duplicate dates or missing observations are present in the index-level and India VIX series used for the analysis.

Sector Return Measurement:

Daily sector returns are calculated from closing index levels using continuously compounded logarithmic returns:

$$R_{i,t} = 100 \times \ln \left(\frac{P_{i,t}}{P_{i,t-1}} \right)$$

where $R_{i,t}$ denotes the return of sector i on trading day t , while $P_{i,t}$ and $P_{i,t-1}$ represent the closing index levels on the current and previous trading days, respectively. Multiplication by 100 expresses the return in percentage terms.

Log returns are used in the correlation and synchronization analyses because they provide a consistent measure of daily price changes across sectoral indices having different index levels.

Identification of Market-Stress Conditions:

India VIX is used to identify market-wide stress conditions. Instead of selecting an arbitrary absolute VIX value, the stress thresholds are determined from the empirical distribution of India VIX over the sample period.

For the daily synchronization analysis, a trading day is classified as high stress when India VIX exceeds the 75th percentile of its sample distribution. The estimated 75th-percentile threshold is approximately 18.27. Accordingly,

$$HighStress_t = \begin{cases} 1, & \text{if India VIX}_t > P_{75} \\ 0, & \text{otherwise} \end{cases}$$

This classification separates periods of elevated market stress from the remaining trading days and allows sectoral returns and correlations to be compared across the two stress conditions.

A stricter threshold is used for identifying major stress episodes in the drawdown and recovery analysis. A major stress episode begins when India VIX exceeds the 90th percentile of its sample distribution, which is approximately 22.36. The episode ends when India VIX remains at or below this threshold for five consecutive trading days. Isolated volatility spikes are excluded by retaining only episodes containing at least three trading days above the P90 threshold. Based on these criteria, ten major market-stress episodes are identified during the sample period.

The two thresholds are used for different parts of the analysis. P75 captures relatively broad periods of elevated stress and is used for the synchronization analysis, whereas P90 identifies more extreme stress episodes for examining sectoral drawdowns and subsequent recoveries.

Sectoral Synchronization:

Sectoral synchronization is examined using two related approaches. First, Pearson correlations between daily returns of the six sectoral indices are calculated separately for high-stress and non-high-stress observations. With six sectors, this produces 15 unique pairwise correlations for each stress regime.

The overall degree of sectoral comovement is summarised using Average Pairwise Correlation (APC):

$$APC_g = \frac{2}{N(N-1)} \sum_{i < j} \rho_{ij,g}$$

where N is the number of sectoral indices, $\rho_{ij,g}$ represents the correlation between sectors i and j , and g denotes the market-stress regime. A higher APC indicates that sectoral returns are moving more closely together.

A time-varying measure of synchronization is also calculated using a 20-trading-day rolling window. For every trading day with sufficient observations, the 15 pairwise correlations are estimated from the preceding 20 trading days and then averaged:

$$RollingAPC_t = \frac{2}{N(N-1)} \sum_{i < j} \rho_{ij,t}^{(20)}$$

A higher value of $RollingAPC_t$ indicates stronger synchronization among sectoral returns during that period.

The relationship between market stress and synchronization is first examined using Spearman's rank correlation between India VIX and $RollingAPC_t$. This is followed by a simple regression:

$$RollingAPC_t = \alpha + \beta VIX_t + \varepsilon_t$$

A complementary specification replaces India VIX with the high-stress dummy:

$$RollingAPC_t = \alpha + \beta HighStress_t + \varepsilon_t$$

Because consecutive 20-day rolling correlations are based on overlapping observations, the regression residuals may contain serial dependence. Newey–West heteroskedasticity- and autocorrelation-consistent standard errors are therefore used, with 19 lags in the main specification. Alternative lag lengths are also considered as a sensitivity check.

Drawdown Measurement:

For each sector and each major stress episode, the severity of the decline is measured relative to the sector's pre-stress peak. The pre-stress peak is defined as the highest closing index level observed during the 20 trading days immediately before the beginning of the stress episode.

The trough is the lowest closing level reached by the sector during the identified stress episode. Percentage drawdown is calculated as:

$$Drawdown_{i,e} = \left(\frac{Trough_{i,e}}{Peak_{i,e}} - 1 \right) \times 100$$

where $Peak_{i,e}$ is the pre-stress peak for sector i in episode e , and $Trough_{i,e}$ is its lowest index level during the episode.

A negative value represents a decline from the pre-stress peak. For statistical comparisons of drawdown severity, the absolute magnitude of the drawdown is used. In this way, a larger value represents a deeper sectoral decline.

Recovery Duration:

Recovery is defined as the first trading day after the episode-specific trough when the sector index closes at or above its corresponding pre-stress peak. Recovery duration is measured as the number of trading days between the trough date and this recovery date.

Formally, if $T_{i,e}$ denotes the trough date and $R_{i,e}$ is the first subsequent trading date satisfying

$$P_{i,R_{i,e}} \geq Peak_{i,e},$$

then recovery duration is calculated as the number of trading days between $T_{i,e}$ and $R_{i,e}$.

The analysis also records cases where another major market-stress episode begins before a sector has recovered to its pre-stress peak. This distinction is important for the robustness analysis because a recovery period extending across another stress episode may be influenced by more than one market disturbance.

Recovery Dispersion:

Recovery dispersion measures how differently the six sectors recover following the same market-stress episode. For each episode, the cross-sector standard deviation of recovery duration is calculated as:

$$RecoveryDispersion_e = SD(R_{e, recoveryDays_{1,e}} \dots RecoveryDays_{N,e})$$

The minimum, maximum, and range of sectoral recovery durations are also reported for each episode. Larger dispersion indicates that sectors recover at quite different speeds following the same market-wide stress event, while lower dispersion indicates more similar recovery patterns.

Statistical Tests:

The number of major stress episodes is relatively small and the episode-level observations may not satisfy the assumption of normality. For this reason, non-parametric tests are used for the main cross-sector comparisons.

The Kruskal–Wallis test examines whether drawdown magnitudes differ across the six sectors. The same test is separately applied to recovery duration to determine whether recovery times differ across sector groups. In both cases, the null hypothesis is that the distributions do not differ systematically across sectors.

Spearman's rank correlation is then used to examine the relationship between drawdown magnitude and subsequent recovery duration. A positive correlation indicates that sectors experiencing deeper drawdowns generally take longer to return to their pre-stress peak.

As a robustness check, the drawdown–recovery correlation is estimated again after excluding observations where another major stress episode begins before the sector completes its recovery. This helps determine whether the relationship remains when recovery periods potentially influenced by subsequent stress events are removed.

Statistical significance is assessed using conventional significance levels, with the 5% level used for the principal hypothesis decisions.

EMPIRICAL RESULTS

Descriptive Statistics and Market-Stress Conditions:

Table 1 presents descriptive statistics for daily returns of the six sectoral indices under non-high-stress and high-stress market conditions.

Table 1. Descriptive Statistics of Sectoral Returns by Market-Stress Regime

Panel A. Non-high-stress regime

Sector	N	Mean (%)	Median (%)	Std. Dev. (%)	Minimum (%)	Maximum (%)
Bank	1,839	0.0878	0.0912	0.9378	−4.3762	7.9839
IT	1,839	0.0814	0.0433	1.0979	−4.8233	5.0152

Pharma	1,839	0.0303	0.0323	1.0502	−4.7712	4.1748
FMCG	1,839	0.0565	0.0365	0.8486	−6.9695	4.3141
Auto	1,839	0.0707	0.0746	1.1126	−4.7196	9.4415
Metal	1,839	0.1019	0.1378	1.4967	−6.8225	6.3145

Panel B. High-stress regime

Sector	N	Mean (%)	Median (%)	Std. Dev. (%)	Minimum (%)	Maximum (%)
Bank	612	−0.0592	−0.0267	2.2153	−18.3130	9.9951
IT	612	−0.0452	0.0484	1.8411	−10.0654	8.6408
Pharma	612	0.0135	−0.0182	1.6091	−9.3507	9.8650
FMCG	612	−0.0046	0.0206	1.3900	−11.1998	7.9906
Auto	612	−0.0131	0.0492	1.9882	−14.9055	9.8997
Metal	612	−0.0107	0.1093	2.4642	−12.3318	9.3875

Note: Daily sector returns are calculated as $100 \times \ln(P_t/P_{t-1})$. High-stress days are defined as observations for which India VIX exceeds the 75th percentile of its sample distribution (approximately 18.27); all remaining observations constitute the non-high-stress regime. The sample period is 1 January 2016 to 31 December 2025. The first return observation is unavailable because calculation of a daily return requires the preceding trading day's closing value.

The descriptive statistics reveal a clear increase in sectoral return variability during high-stress market conditions. The standard deviation of returns increases for all six sectors. The largest proportional increase is observed for Bank, where the standard deviation rises from 0.9378% during non-high-stress periods to 2.2153% during high-stress periods. Return variability also increases from 1.1126% to 1.9882% for Auto, from 1.0979% to 1.8411% for IT, from 1.4967% to 2.4642% for Metal, from 0.8486% to 1.3900% for FMCG, and from 1.0502% to 1.6091% for Pharma.

Average sectoral performance also weakens under elevated market stress. Mean returns become negative for Bank (−0.0592%), IT (−0.0452%), FMCG (−0.0046%), Auto (−0.0131%), and Metal (−0.0107%). Pharma is the only sector with a marginally positive mean return during high-stress conditions (0.0135%). This descriptive pattern should not, however, be interpreted as evidence of statistically superior resilience.

The high-stress regime also contains substantially larger extreme movements. Bank records a minimum daily return of −18.3130%, while Auto and Metal experience minimum returns of −14.9055% and −12.3318%, respectively. Overall, the results indicate that elevated market stress is associated with substantially greater return variability and weaker average performance across most

sectors. The following section examines whether this increase in market stress is also accompanied by stronger synchronization across sectoral returns.

Sectoral Synchronization During Market Stress:

The analysis next examines whether sectoral returns become more synchronized when market-wide stress increases. Table 2 reports the average pairwise correlation (APC), the association between India VIX and the 20-day rolling synchronization measure, and the HAC regression estimates.

Table 2. Sectoral Synchronization and Market Stress

Measure	Estimate	HAC SE	t-statistic	p-value
APC: Non-high-stress regime	0.3632	—	—	—
APC: High-stress regime	0.5907	—	—	—
Relative increase in APC (%)	62.62	—	—	—
Spearman: India VIX vs. SYNC20	0.3584	—	—	<0.001
India VIX → SYNC20	0.0099	0.0014	6.974	<0.001
High-stress dummy → SYNC20	0.1067	0.0277	3.856	<0.001

Note: APC denotes the average of the 15 unique pairwise return correlations among the six sectoral indices. High-stress days are observations for which India VIX exceeds the 75th percentile of its sample distribution. SYNC20 is the average of the 15 pairwise sectoral return correlations calculated over a rolling 20-trading-day window. The regression estimates use Newey–West heteroskedasticity- and autocorrelation-consistent (HAC) standard errors with 19 lags. The rolling synchronization regression contains 2,432 observations.

The results show a substantial increase in sectoral synchronization during periods of elevated market stress. Average pairwise correlation increases from 0.3632 during non-high-stress conditions to 0.5907 during high-stress conditions, corresponding to an increase of approximately 62.62%. Moreover, all 15 unique sector pairs exhibit higher correlations in the high-stress regime. This broad-based increase indicates that stronger comovement during stressful market conditions is not confined to a small number of sector combinations.

The rolling-window analysis provides additional evidence of a positive relationship between market stress and sectoral synchronization. The Spearman correlation between India VIX and SYNC20 is 0.3584 and statistically significant ($p < 0.001$). Thus, higher levels of market stress tend to coincide with stronger sectoral return comovement.

The HAC regression produces a positive India VIX coefficient of 0.0099 (HAC SE = 0.0014, $t = 6.974$, $p < 0.001$). This estimate indicates that a one-point increase in India VIX is associated with an increase of approximately 0.0099 in the 20-day synchronization measure. As an illustrative interpretation of the linear specification, a ten-point increase in India VIX corresponds to an increase of approximately 0.099 in sectoral synchronization.

The high-stress dummy specification provides consistent evidence. The estimated coefficient is 0.1067 (HAC SE = 0.0277, $t = 3.856$, $p < 0.001$), indicating that the rolling synchronization measure is approximately 0.107 correlation points higher during high-stress conditions than during other periods. The statistical significance of the VIX coefficient is also preserved across alternative HAC lag specifications, indicating that the main inference is not dependent on the selected lag length.

Taken together, the regime-based correlations, rolling synchronization measure, rank correlation, and HAC regressions provide consistent evidence that Indian sectoral indices become more synchronized as market-wide stress increases. The findings therefore support the hypothesis that sectoral synchronization is higher during periods of elevated market stress.

Major Market-Stress Episodes:

The P90-based identification procedure yields ten major market-stress episodes over the 2016–2025 sample period. Table 3 reports the timing and India VIX characteristics of these episodes. The episodes differ considerably in both duration and intensity, indicating that elevated market stress in India has occurred through both short-lived volatility shocks and more persistent periods of market uncertainty.

Table 3. Major Market-Stress Episodes Identified Using India VIX

Episode	Start date	End date	Trading days	P90 stress days	Peak VIX	Mean VIX
1	10 Feb 2016	25 Feb 2016	12	8	25.97	22.78
2	18 Apr 2019	22 May 2019	22	20	28.66	25.30
3	28 Feb 2020	10 Aug 2020	110	110	83.61	36.69
4	20 Oct 2020	4 Nov 2020	12	10	25.21	23.32
5	11 Jan 2021	9 Mar 2021	38	31	28.14	23.63
6	12 Apr 2021	4 May 2021	15	12	23.69	22.51
7	14 Feb 2022	28 Mar 2022	29	25	31.98	25.31
8	11 May 2022	26 May 2022	12	11	25.64	23.74
9	13 Jun 2022	20 Jun 2022	6	4	22.87	22.41
10	27 May 2024	4 Jun 2024	7	6	26.75	24.01

Note: Major stress episodes are identified using the 90th percentile of the India VIX distribution (approximately 22.36). An episode begins when India VIX exceeds this threshold and ends after five consecutive trading days at or below the threshold. Only episodes containing at least three P90 stress days are retained. P90 stress days indicate the number of trading days within each episode on which India VIX exceeds the P90 threshold.

The most prominent episode occurs in 2020, corresponding to the severe market disruption associated with the COVID-19 period. This episode extends from 28 February to 10 August 2020 and contains 110 trading days, all of which exceed the P90 threshold. India VIX reaches a sample maximum of 83.61 during this episode, with a mean value of 36.69, substantially exceeding the intensity observed in the other identified stress periods.

The remaining episodes are considerably shorter, although several also exhibit pronounced market stress. The episode beginning in February 2022 records a peak India VIX of 31.98, while the April–May 2019 and January–March 2021 episodes reach peaks of 28.66 and 28.14, respectively. The shortest identified episode occurs in June 2022, lasting six trading days and containing four P90 stress days. Overall, the episodes display substantial variation in both duration and intensity.

The variation in the duration and intensity of these episodes provides the basis for examining how the six sectoral indices respond to common market-wide disturbances. The following section therefore evaluates sector-specific drawdown magnitudes and the time required for each sector to regain its pre-stress level.

Sectoral Drawdowns and Recovery Dynamics:

Table 4 summarizes sectoral drawdown magnitude and subsequent recovery duration across the ten major market-stress episodes. Drawdown is measured relative to the highest sector-index level during the 20 trading days preceding each stress episode, while recovery duration represents the number of trading days required for the sector to regain that pre-stress peak following its episode-specific trough.

Table 4. Sectoral Drawdown and Recovery Characteristics

Sector	Episodes	Mean drawdown (%)	Median drawdown (%)	Worst drawdown (%)	Mean recovery days	Median recovery days
Bank	10	–13.13	–10.61	–46.28	48.4	20.0
IT	10	–12.16	–8.30	–33.35	117.9	28.0
Pharma	10	–9.47	–9.89	–23.23	110.1	53.0
FMCG	10	–7.84	–6.07	–25.31	26.0	14.5
Auto	10	–12.35	–10.13	–44.78	64.3	18.5
Metal	10	–16.05	–12.81	–44.80	76.1	13.0

Note: Drawdown is the percentage decline from the highest closing index level during the 20 trading days preceding a major stress episode to the lowest closing level observed during that episode. More negative values indicate deeper drawdowns. Recovery duration is the number of trading days from the episode-specific trough until the sector index first closes at or above its corresponding pre-stress peak. Statistics are calculated across the ten major stress episodes identified using the P90 India VIX criterion.

The descriptive results indicate meaningful variation in the magnitude of sectoral losses during major stress episodes. Metal records the deepest average drawdown at 16.05%, followed by Bank at 13.13%, Auto at 12.35%, and IT at 12.16%. Pharma and FMCG exhibit smaller average drawdowns of 9.47% and 7.84%, respectively. The most severe individual drawdown is observed for Bank at 46.28%, while Metal and Auto also experience declines exceeding 44% in their worst episodes.

Recovery patterns do not correspond directly to the ranking of drawdown severity. IT records the longest mean recovery duration at 117.9 trading days, followed by Pharma at 110.1 days. In contrast, FMCG records the shortest mean recovery duration at 26.0 trading days, while Bank averages 48.4 days. Metal, despite experiencing the deepest average drawdown, has a median recovery duration of only 13 trading days. The difference between mean and median recovery durations for several sectors indicates that a small number of prolonged recoveries substantially increase the average recovery time.

Recovery speeds also vary considerably within individual stress episodes. The COVID-19 episode produces an average sectoral drawdown of approximately 36.29%, making it the deepest common sectoral decline among the identified episodes. However, the longest recovery periods are not confined to the COVID-19 shock. Some subsequent episodes contain substantial differences between the fastest- and slowest-recovering sectors, demonstrating that the depth of the initial market decline and the subsequent recovery process need not follow identical patterns.

All 60 sector–episode observations eventually regain their corresponding pre-stress peaks within the available sample. However, in 14 cases another major stress episode begins before recovery from the preceding episode is completed. These observations are retained in the main analysis because they represent the actual sequence of market conditions, while a separate robustness analysis excludes them when examining the relationship between drawdown magnitude and recovery duration.

Overall, the descriptive evidence suggests considerable heterogeneity in sectoral drawdowns and recovery speeds. These differences are descriptive and do not by themselves establish statistically significant differences across sectors. Formal cross-sector tests and the relationship between drawdown severity and recovery duration are examined in the following section.

Statistical Tests and Robustness:

Table 5 reports the non-parametric tests of cross-sector differences in drawdown magnitude and recovery duration, together with the relationship between drawdown severity and subsequent recovery time.

Table 5. Statistical Tests of Sectoral Drawdown and Recovery

Test	Statistic	p-value	N	Conclusion
Kruskal–Wallis: Drawdown magnitude across sectors	H = 6.342	0.274	60	Not significant
Kruskal–Wallis: Recovery duration across sectors	H = 2.838	0.725	60	Not significant
Spearman: Drawdown magnitude vs. recovery duration	$\rho = 0.722$	<0.001	60	Significant
Spearman: Non-overlapping recoveries	$\rho = 0.678$	<0.001	46	Significant

Note: Drawdown magnitude is expressed as the absolute percentage decline from the pre-stress peak to the episode-specific trough. Recovery duration is measured in trading days from the trough until

the sector regains its pre-stress peak. The non-overlapping specification excludes sector–episode observations in which another major stress episode begins before recovery from the preceding episode is completed. Statistical significance is evaluated at the 5% level.

The Kruskal–Wallis test does not identify statistically significant differences in drawdown magnitude across the six sectors (**H = 6.342, p = 0.274**). Therefore, although the descriptive results show that sectors such as Metal and Bank experience larger average drawdowns than FMCG and Pharma, the episode-level evidence does not establish that the distributions of drawdown magnitude differ systematically across sectors.

A similar conclusion applies to recovery duration. The Kruskal–Wallis statistic is 2.838 with a p-value of 0.725, indicating no statistically significant difference in recovery duration across the six sector groups. The substantial descriptive differences in mean and median recovery times reported in Table 4 should therefore be interpreted as observed sample patterns rather than evidence of systematic cross-sector differences.

A considerably stronger result emerges when drawdown severity is related directly to subsequent recovery duration. The Spearman rank correlation between drawdown magnitude and recovery duration is positive and statistically significant (**$\rho = 0.722$, $p < 0.001$**). This indicates a strong tendency for deeper sectoral drawdowns to be associated with longer periods required to regain the corresponding pre-stress peak.

The relationship remains strong after observations affected by subsequent major stress episodes are excluded. For the 46 non-overlapping sector–episode observations, the Spearman correlation remains positive and statistically significant (**$\rho = 0.678$, $p < 0.001$**). The persistence of the relationship in this restricted sample indicates that the main drawdown–recovery association is not solely attributable to recovery periods that extend through subsequent major stress episodes.

Taken together, the results indicate that sector identity alone does not produce statistically significant differences in drawdown severity or recovery duration across the identified episodes. In contrast, the severity of the initial drawdown is strongly associated with the subsequent recovery period. Thus, the evidence suggests that the magnitude of losses experienced during market stress is more closely related to recovery time than broad sector classification.

DISCUSSION

The findings provide evidence that market-wide stress is associated with important changes in the way Indian sectoral indices move and recover. Three broad observations emerge from the analysis. First, sectoral returns become substantially more synchronized when market stress increases. Second, although sectors display noticeable differences in drawdown severity and recovery speed, these differences are not statistically significant across the identified stress episodes. Third, the magnitude of a sector's drawdown is strongly associated with the time subsequently required to recover its pre-stress level.

The increase in sectoral synchronization is particularly important from a diversification perspective. Under non-high-stress conditions, the six sectors exhibit an average pairwise correlation of 0.363, whereas the corresponding correlation increases to 0.591 during high-stress conditions. The increase occurs across all 15 sector pairs, suggesting that the pattern is broad rather than being driven by only a few closely related sectors. The rolling-window results reinforce this evidence, with higher India

VIX levels significantly associated with greater sectoral synchronization even after accounting for serial dependence arising from overlapping correlation windows.

This pattern suggests that diversification across broad sectors may become less effective precisely when market conditions deteriorate. During relatively normal conditions, differences in sector-specific fundamentals can allow sectoral indices to move with some independence. When market-wide uncertainty becomes elevated, however, common influences may become more dominant, causing sectoral movements to converge. Consequently, portfolios that appear diversified across industries under normal market conditions may still be exposed to substantial common movement during periods of severe stress.

The drawdown results provide a different perspective on sectoral vulnerability. Metal records the deepest average drawdown across the identified episodes, while FMCG experiences the smallest. Similarly, recovery times differ considerably in descriptive terms, with IT and Pharma displaying longer average recovery durations than several other sectors. However, the Kruskal–Wallis tests do not indicate statistically significant cross-sector differences in either drawdown magnitude or recovery duration. These results suggest that observed differences in sector averages should not automatically be interpreted as stable sector-specific characteristics.

The absence of statistically significant sector differences is itself informative. Major market-stress episodes differ considerably in their origin, severity and duration. A sector that is relatively resistant to one shock may be more exposed to another. The results therefore suggest that sectoral vulnerability is not determined solely by broad industry classification. The characteristics of individual stress episodes and the magnitude of losses experienced during those episodes may be equally, or more, relevant for understanding subsequent market performance.

This interpretation is reinforced by the strong positive relationship between drawdown magnitude and recovery duration. The rank correlation indicates that sectors experiencing deeper declines generally require longer periods to regain their pre-stress peaks. Importantly, this relationship remains strong after excluding observations in which another major stress episode begins before recovery is completed. The result therefore appears to represent a persistent feature of the drawdown–recovery process rather than merely an effect of overlapping market disturbances.

The distinction between synchronization and recovery also provides an important insight. Market stress appears to generate a common response across sectors in the form of increased contemporaneous comovement, but the subsequent recovery process remains comparatively heterogeneous. Sectors may fall together when market-wide uncertainty rises without necessarily recovering at the same speed. Stress-period synchronization should therefore not be interpreted as implying identical post-stress trajectories.

The results have practical implications for investors and portfolio managers. Sector diversification can remain useful under ordinary conditions, but its protective value may weaken when market-wide stress rises and correlations increase. Risk assessment during such periods may therefore benefit from considering both the possibility of stronger cross-sector comovement and the depth of portfolio drawdowns. The strong association between drawdown severity and recovery duration further suggests that downside risk should be evaluated not only in terms of the magnitude of immediate losses but also in terms of the time potentially required to restore portfolio value.

Overall, the evidence presents market stress as a two-stage process. During the stress phase, sectoral movements become increasingly synchronized, increasing exposure to common market risk. During the post-stress phase, recovery paths become more differentiated, with deeper drawdowns generally associated with longer recovery periods. Considering synchronization, drawdown severity and recovery duration together therefore provides a more complete view of sectoral behaviour during episodes of market-wide stress than examining contemporaneous returns alone.

CONCLUSION

This study examines sectoral synchronization, drawdown severity, and recovery dynamics during periods of market-wide stress in the Indian equity market. Using daily observations for six major NIFTY sectoral indices and India VIX from January 2016 to December 2025, the analysis distinguishes between elevated daily stress conditions and major stress episodes. This framework allows market stress to be examined from two related perspectives: whether sectors move more closely together when uncertainty rises and how they subsequently differ in the depth and duration of losses.

The findings provide clear evidence that sectoral synchronization increases during periods of elevated market stress. Average pairwise correlation rises substantially under high-stress conditions, and the positive relationship between India VIX and rolling sectoral synchronization remains statistically significant after applying HAC standard errors. The increase is observed across all sector pairs, indicating that stress-related synchronization is broad based rather than concentrated in a limited set of industries.

The drawdown and recovery analysis provides a more differentiated picture. Although sectors display noticeable differences in average drawdown magnitude and recovery duration, the Kruskal–Wallis tests do not establish statistically significant differences across sector groups. Sector classification alone therefore appears insufficient to explain the variation in losses and subsequent recovery across the identified market-stress episodes.

In contrast, drawdown severity is strongly related to recovery duration. Sectors experiencing deeper declines generally require longer periods to regain their pre-stress peaks. This relationship remains statistically significant after excluding recovery observations interrupted by subsequent major stress episodes. The evidence therefore indicates that the depth of the initial loss provides useful information about the subsequent recovery process.

These findings have implications for portfolio risk management. Diversification across sectors may provide less protection during periods of severe market stress because correlations tend to rise when market-wide uncertainty increases. At the same time, post-stress recovery cannot be inferred simply from sector classification. Investors may therefore benefit from considering both stress-dependent changes in correlation and drawdown severity when evaluating downside exposure and potential recovery horizons.

The study is subject to several limitations. The analysis focuses on six major Indian sectoral indices and therefore does not represent every segment of the Indian equity market. The identification of stress regimes and major episodes is based on sample-relative India VIX percentile thresholds, while alternative definitions of market stress could produce somewhat different episode classifications. Recovery is defined as the first return to the pre-stress peak and does not capture the path of prices

within the recovery period. In addition, the analysis identifies statistical associations and does not establish causal effects of market stress on sectoral synchronization or recovery.

Future research could extend the analysis to a broader set of sectoral and thematic indices, alternative measures of market uncertainty, or comparisons across emerging markets. Further work could also examine the economic and sector-specific characteristics that explain why some sectors recover more quickly than others following similar market-wide disturbances.

Overall, the study shows that market stress has implications beyond an immediate increase in volatility. Indian sectors become more synchronized as stress intensifies, while their subsequent recovery paths remain heterogeneous. Most importantly, deeper drawdowns are associated with longer recovery periods. Jointly considering synchronization, drawdown severity, and recovery duration therefore provides a broader understanding of sectoral behaviour during and after periods of market-wide stress.

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