

Is Diversification Effective in the Face of a Black Swan Event? A Case Study of COVID-19

By Ryan Bertschinger

Executive Summary

In an era marked by unforeseen events and global disruptions, the essence and efficacy of portfolio diversification have been thrown into the limelight. This report seeks to dissect the role of diversification during the pre and post-COVID-19 periods, analysing its successes and pitfalls. Drawing upon extensive data and correlation analysis across various asset classes—including commodities, equities, property, and fixed income—we unveil compelling insights.

Key findings reveal the limited effectiveness of diversification, with only gold and bonds standing out as consistently strong diversification tools across either periods. The correlation profiles of certain assets remained remarkably consistent despite the pandemic, offering potential stability in investment strategies. In contrast, assets like gold, bonds, REITs, and Walmart displayed significant shifts in correlation profiles, emphasizing the importance of dynamic portfolio management.

The overarching message is clear: While diversification remains a critical investment strategy, its practical application is intricate and demands a blend of historical understanding, contemporary analysis, and forward-looking adaptability. As the financial landscape continually evolves, so too must our strategies, ensuring that portfolios are not just diversified but wisely so.

Diversification

In a perfect world, an investor would pick just one asset—a self-proclaimed "silver bullet". This asset would outperform the market during bullish phases and mitigate risk during bearish cycles. Unfortunately, this "silver bullet" rarely exists because every asset carries its own individual, independent risks: non-systematic risk.

From the perspective of an investor: operational, industry, and/or management risks are essentially unavoidable—they're inherent to ALL individual assets. Therefore, the ultimate question that arises is: how can one construct a portfolio that maximizes returns for a given level of risk?

A Practical Solution

The time-tested response to this conundrum is Diversification, the practice of spreading investments across a variety of assets to reduce exposure to any single risk. Unlike the elusive "silver bullet," diversification doesn't promise perfection—it offers pragmatism.

According to Modern Portfolio Theory, this approach allows for the highest possible returns for a given level of risk. Or rather, minimizing risk for an expected return. This study extends the discussion of diversification across various asset classes: Commodities, Equities, Property, and Fixed Income.

The goal is not just to diversify, but to diversify wisely, selecting asset classes that have varying degrees of correlation with the market, especially during black swan events like COVID-19. The ultimate question this study addresses is: Can diversification stand its ground against unprecedented market upheavals?

Approach

To gain a comprehensive understanding of asset correlations, the data was segmented into two critical timeframes: pre and post the onset of COVID-19. This juxtaposition sheds light on the contrasting behaviours of assets during times of regular market dynamics and times of unprecedented disruptions like the pandemic. By adopting an incremental approach to correlation, we can capture the evolving relationships between assets

across different market conditions. This method, known as conditional correlation, offers dynamic insights into asset interactions under specific scenarios, making it pivotal for assessing the effectiveness of diversification.

Diversification, at its core, aims to mitigate investment risk by holding a diverse set of assets that don't synchronously move. Ideally, during bullish markets, assets with high correlations are desirable, as they indicate an ability to capitalize on upward momentum. Conversely, in bearish markets, assets with lower correlations are preferred, signifying resistance against the broader market downturn. Through conditional correlation, investors are equipped to strategically craft portfolios that harness gains during market highs and protect against substantial losses in challenging times.

Analysis Process

1. Data Segmentation: Given March 6th, 2020 as a pivotal date, the data splits into 'Pre-COVID' and 'Post-COVID' segments. The entirety of return percentages is preserved for in-depth analysis. This date is the most recent data point prior to the WHO pandemic announcement on 11th March.
2. Threshold Creation for Correlation: With ``numpy``, the S&P 500 returns' range is determined. Using ``INCREMENT``, thresholds are set, categorizing data into cumulative return percentages.
3. Correlation Calculation: For each threshold, data subsets are obtained. Correlations for data points, both above and below the threshold, are established using Pearson's coefficient. This method is consistently applied to compare all assets to the S&P 500. Specifically, for a threshold ``x``, correlations are assessed where ``data['S&P 500'] < x`` and ``data['S&P 500'] > x``.
4. Graphical Display: Using ``matplotlib.pyplot``, line graphs depict correlations for 'Pre-COVID' and 'Post-COVID' periods, and bar graphs represent average correlations for assets across these phases.
5. Ranking Analysis: Assets are ranked by their correlation difference during positive and negative returns, using ``diff = round(pos_corr - neg_corr,3)``. A substantial difference indicates the asset's diversification strength. Assets are sorted by this criterion with ``df = df.sort_values(by="Difference", ascending=False)``, helping identify the top diversifying assets for both periods.

Data

The dataset, sourced from Bloomberg using the `BDH()` function, spans from 2016-09-02 to 2023-09-15, with a focus on weekly data to minimize daily market volatility. The analysis employs parameters `INCREMENT = 0.002` and `MIN_DATA_POINTS = 5`, ensuring nuanced data segmentation and conclusions drawn from substantial data points. The COVID-19 pandemic's onset within this dataset is identified as 2020-03-06, offering a defined pre and post-pandemic assessment framework.

Assets analysed encompass Equities such as Apple Inc. (AAPL:US), Tesla Inc. (TSLA:US), and Walmart Inc. (WMT:US); Commodities like Gold (GC1:COM), Brent Crude (CO1:COM), and Corn (C 1:COM); the Cryptocurrency Bitcoin (XBT:CUR); Property via iShares Global REIT ETF (REET:US); and Fixed Income represented by iShares 5-10 Year Investment Grade Corporate Bond ETF (IGIB:US).

The S&P 500 serves as the market benchmark, capturing roughly 80% of the U.S. stock market value, epitomizing the overall economic health. Key commodities such as Gold, Brent Crude, and Corn reflect global economic dynamics, tracking inflation, energy, geopolitical events, and agriculture, respectively. The chosen Property and Fixed Income proxies, iShares Global REIT ETF and iShares 5-10 Year Investment Grade Corporate Bond ETF, shed light on property market movements and medium-term maturities in corporate bonds, giving insights into broader economic indicators.

Pre-COVID Results

Asset	Correlation (Returns > 0)	Correlation (Returns < 0)	Difference
Bond	0.018	-0.027	0.045
Gold	0.105	0.14	-0.035
Corn	0.024	0.113	-0.089
TSLA US	0.134	0.332	-0.198
REIT	0.333	0.673	-0.34
WMT US	0.251	0.612	-0.361
Brent Crude	0.077	0.445	-0.368
AAPL US	0.254	0.641	-0.387

Table 1: Pre-COVID correlations with S&P 500 after data has been split into positive and negative returns. Data is ranked in descending order based on the difference column.

Post-COVID Results:

Asset	Correlation (Returns > 0)	Correlation (Returns < 0)	Difference
Gold	0.333	0.255	0.078
WMT US	0.188	0.234	-0.046
Bond	0.638	0.695	-0.057
Corn	0.023	0.088	-0.065
AAPL US	0.542	0.619	-0.077
REIT	0.758	0.841	-0.083
TSLA US	0.338	0.426	-0.088
Brent Crude	0.06	0.401	-0.341

Table 2: Post-COVID correlations with S&P 500 after data has been split into positive and negative returns. Data is ranked in descending order based on the difference column.

Gold

Historically celebrated as a 'safe haven' asset, gold has been a sanctuary for investors in times of economic upheaval. With its intrinsic value and limited supply, it has consistently acted as both a hedge against inflation and a crucial diversification tool.

The post-pandemic phase revealed an upward sloping correlation graph for gold (Figure 1). This indicates that as the S&P 500's returns ascended, so did the pairwise correlation. This behaviour is particularly prominent when S&P's returns surpass 0.02, signifying gold's ability in capturing the market's upward movements during these times.

Perhaps even more pivotal from a diversification perspective is gold's performance during market slumps. Throughout the instances where the S&P 500 dipped into negative territory, gold's correlation remained consistently below 0.5. In addition to this, gold emerged as the only asset to display a positive differential between its correlations for positive S&P 500 returns and negative ones.

However, the pre-COVID times painted a contrasting picture for gold. Here, gold showed a pronounced vulnerability during bearish market phases, evident from its high correlation with extreme negative S&P 500 returns. And aside from a noticeable uptick in correlation on the far right (potentially due to fewer data points in the tails of a less-volatile pre-COVID era), gold remained largely unresponsive to bullish market trends.

This divergence in gold's pre and post-pandemic correlation behaviours could be attributed to a variety of factors. The pandemic gave rise to unparalleled economic, political and health-related uncertainties, often driving investors to the perceived safety of gold. Moreover, geopolitical conflicts, such as the ongoing Russia-Ukraine conflict have only further decreased certainty/confidence.

In conclusion, the post-COVID era has reaffirmed gold's stature as an indispensable asset for diversification. With its ability to harness market highs and its resilience during lows, gold stands out as a strategic asset for portfolio constructions in our current investment climate

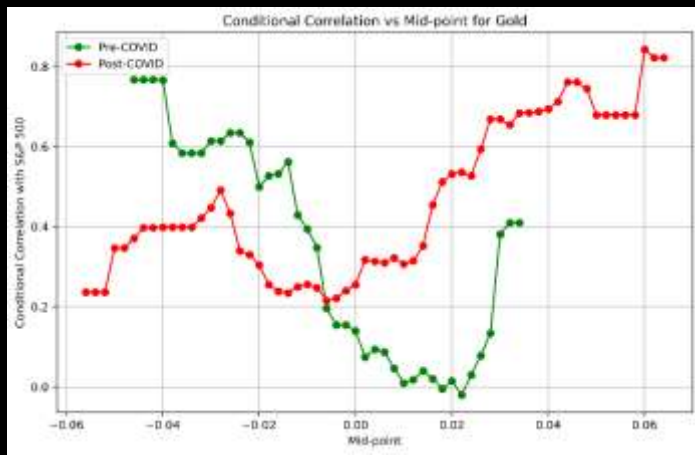


Figure 1: Line graph showing Gold's conditional correlation with the S&P 500, pre- and post-COVID

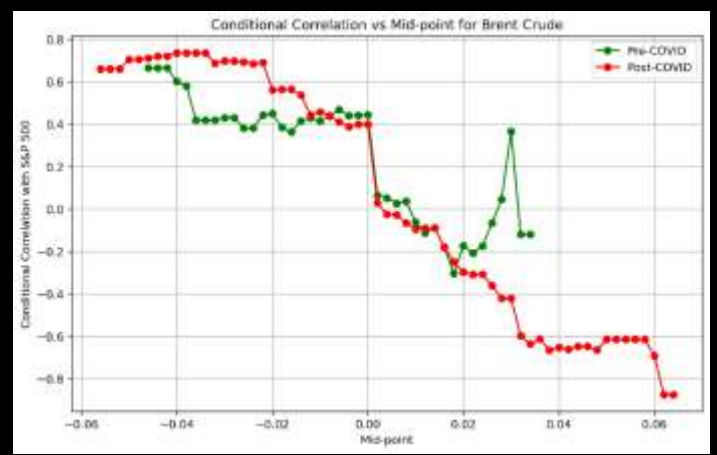


Figure 2: Line graph showing Brent Crude Oil's conditional correlation with the S&P 500, pre- and post-COVID

Brent Crude Oil & Corn

As opposed to Gold, Brent Crude Oil (Figure 2) and Corn (Figure 3) act as both consumption and investment assets. They're essential for energy and food and play roles in investment portfolios.

After COVID-19 began, both Brent Crude Oil and Corn showed downward trends in their correlation with the S&P 500's returns. Brent Crude Oil's decline was steady, while Corn's was more variable, especially with a sharp increase for S&P returns > 0.03 .

Looking closer at Brent Crude Oil, its correlations with S&P returns < 0 remained high both before and after COVID-19, making it less ideal for diversification. Post-COVID, this correlation dropped significantly for S&P returns over 0.03. Brent Crude Oil's low ranking in correlation difference, especially post-COVID, is worth noting. The pre-COVID data had a sudden increase for returns over 0.02, likely due to volatile oil prices from COVID-19 and the Russia-Ukraine conflict. These findings suggest that Brent Crude Oil wasn't a great diversification asset during these times.

Corn, however, was more consistent. Its correlations before and after COVID-19 were similar, suggesting the pandemic didn't majorly affect its relationship with the S&P 500. This might be because Corn's role in the food supply chain remained crucial as ever. Notably, its correlation never went below -0.4, making it stable for diversification. In the correlation difference rankings, Corn did better than Brent Crude Oil, especially since its positive returns didn't dip into strong negative correlation like oil did.

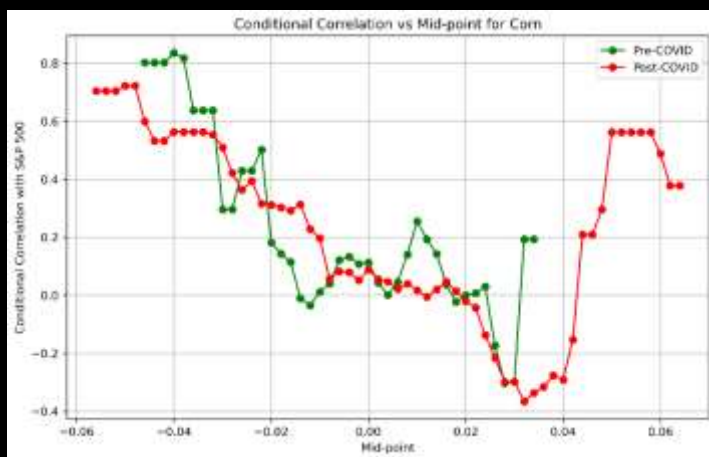


Figure 3: Line graph showing Corn's conditional correlation with the S&P 500, pre- and post-COVID

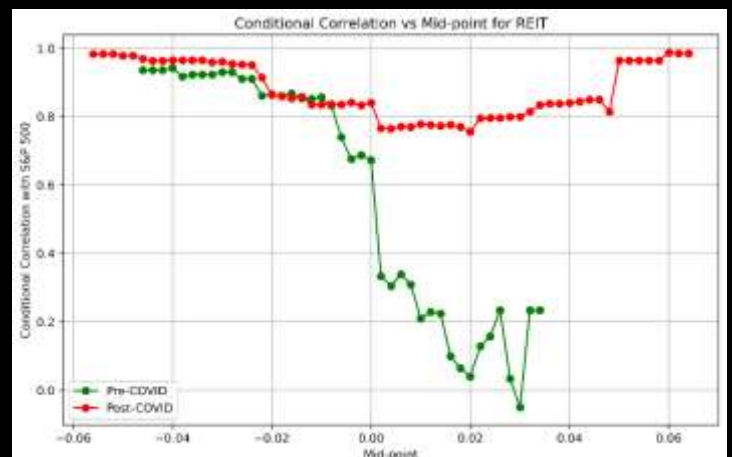


Figure 4: Line graph showing REIT's conditional correlation with the S&P 500, pre- and post-COVID

Property

Post the onset of the pandemic, property (Figure 4) exhibited a remarkably high correlation with the S&P 500. Across all price ranges, this correlation never fell below 0.7. For negative S&P returns, the correlation was 0.758, and it surged further for positive returns to 0.841. Such strong ties could be attributed to liquidity challenges. Amidst the pandemic's chaos, there was a rush for liquidity, prompting investors to liquidate various assets, including properties. This mass selling potentially made property prices and the broader market move in sync, resulting in elevated correlations. From a diversification standpoint, these correlations imply a diminished protective role of property in a portfolio during this period.

Contrastingly, in the pre-pandemic phase, property exhibited a diverse correlation pattern with the S&P 500. While there was a pronounced correlation of 0.673 for negative S&P returns, particularly towards the more extreme negative returns, it saw a decline for positive returns, settling at a much lower 0.333. This downward shift, especially the steep drop as returns transitioned from negative to positive, suggests a nuanced interplay between property prices and market sentiments. The divergence in property's pre and post-COVID correlation with the S&P 500 is stark and underlines the changing dynamics of the property market in relation to broader market movements. Factors like global urbanization trends, shifting demographics, and investor preferences might have made the property market behave distinctly, sometimes insulating it from short-term market fluctuations.

Bonds

In the aftermath of the pandemic, bonds (Figure 5) showcased a correlation trend strikingly like that of REITs. While one might initially attribute this to the liquidity crunch, similar to property, it's essential to recognize that bonds operate within a different financial ecosystem, driven by investors seeking safety amidst uncertain times.

Transitioning to the pre-pandemic era, bonds exhibited qualities that made them an excellent diversification tool, particularly during bear markets. Notably, for negative market returns, the bond correlation with the S&P 500 remained remarkably subdued, never crossing the 0.1 threshold. In fact, it was the only asset during this period to exhibit a negative correlation for declining market returns. This behaviour ranked bonds 1st, with a value of 0.045, when comparing the difference in correlations for positive and negative market returns. This negative correlation during downturns underscores bonds' ability to act as a counterweight, potentially offsetting losses from other portfolio components.

The shift from this robust pre-COVID diversification characteristic to a more muted role post-COVID could be attributed to the global synchronized response to the pandemic. As central banks embarked on expansive monetary measures and investors worldwide sought safety, the distinctiveness of bonds might have been temporarily overshadowed. This transition emphasizes the need for periodic portfolio reassessments, ensuring alignment with the evolving market dynamics.

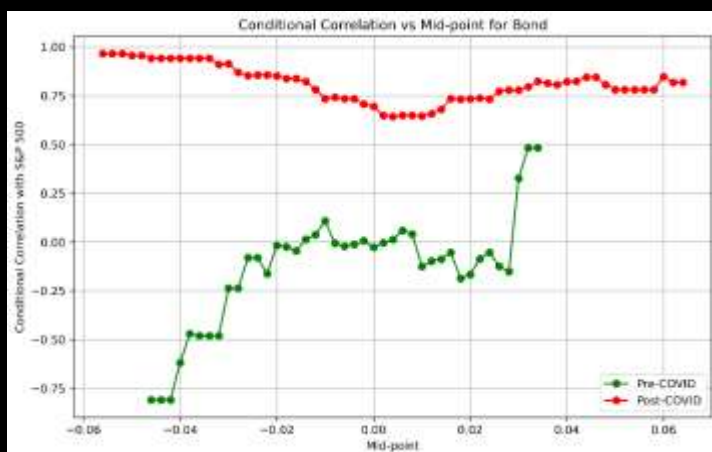


Figure 5: Line graph showing iShares 5-10 Year Investment Grade Corporate Bond ETF's conditional correlation with the S&P 500, pre- and post-COVID

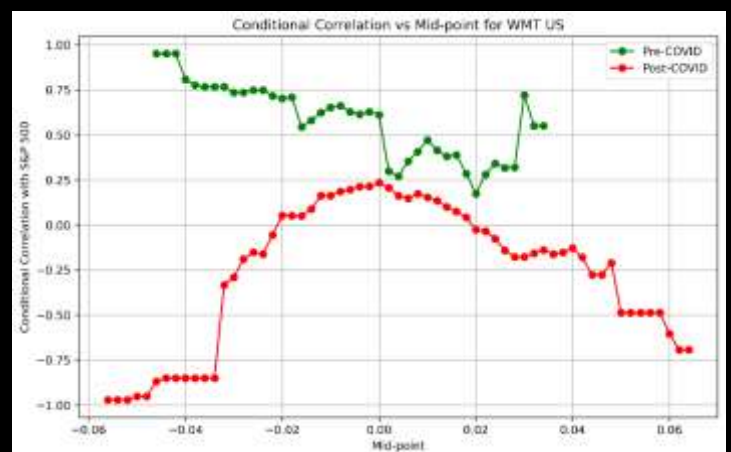


Figure 6: Line graph showing Walmart's conditional correlation with the S&P 500, pre- and post-COVID

Walmart

Post-COVID, Walmart's correlation with the S&P 500 (Figure 6) adopted a unique arch shape, displaying an overall inverse relationship with the S&P 500, especially at the extremes of the curve. Specifically, when the S&P 500 showcased negative returns, Walmart registered a correlation of 0.234, which changed slightly to 0.188 for positive returns. This gave Walmart a post-COVID correlation difference of -0.046, placing it second in the rankings. This pattern suggests that Walmart could offer diversification benefits, especially during market downturns. However, its low correlations during bullish markets indicate that it may not be the best constant diversification choice throughout all market phases.

Contrastingly, the pre-COVID landscape for Walmart was almost the opposite. The correlation curve initially sloped downwards but then took an upward trajectory, maintaining a correlation above 0.5 for all negative intervals. This high correlation during market declines makes Walmart less ideal for diversification across such periods. However, for S&P 500 returns greater than 0.02, Walmart's correlation did show improvement. Yet, when considering the difference in correlations for positive and negative returns, Walmart was one of the underperformers, ranking sixth with a correlation of 0.251 for positive returns and 0.612 for negative.

The striking dissimilarity between Walmart's pre and post-COVID correlation curves raises questions. This transformation from being mostly positively correlated pre-COVID to largely negative post-COVID might be attributed to changing consumer behaviours and priorities during the pandemic. This adaptability of correlation can make Walmart an intriguing option for dynamic diversification, wherein its role in a portfolio is adjusted based on broader market conditions.

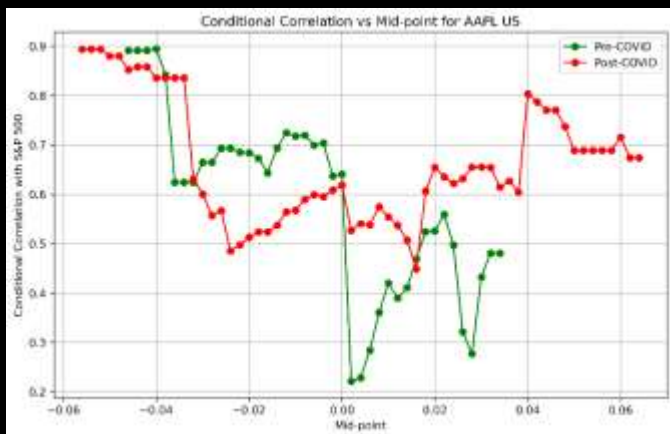


Figure 7: Line graph showing Apple's conditional correlation with the S&P 500, pre- and post-COVID

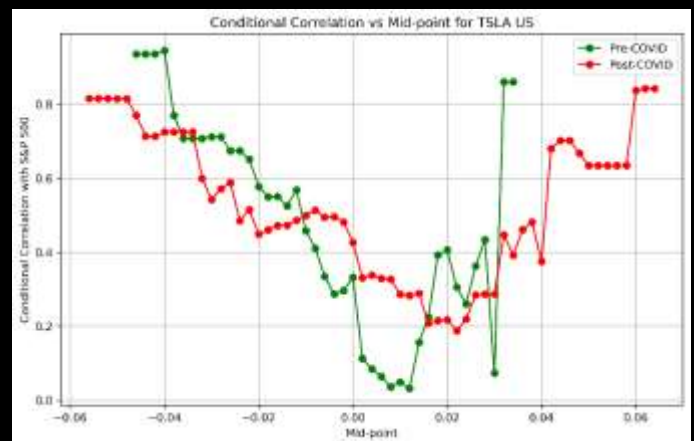


Figure 8: Line graph showing Tesla's conditional correlation with the S&P 500, pre- and post-COVID

Apple & Tesla

Apple (Figure 7) and Tesla (Figure 8), two behemoths in the tech sector, offer a distinct risk and return profile compared to traditional equities. As tech stocks, they often exhibit amplified reactions to technological advancements, regulatory news, and market speculation, which can result in varying diversification opportunities.

Both Apple and Tesla's correlation curves with the S&P 500 are more jagged compared to the smoother trend exhibited by Walmart. This could be attributed to the inherent volatility and rapid shifts often associated with tech stocks. Pre-COVID, the correlation charts indicate a heightened sensitivity to significant market downturns, with correlations starting notably high and then sharply descending toward a range between 0 and 0.5. This pattern is particularly pronounced for Apple, which ranked last in terms of correlation difference pre-COVID, registering a value of -0.368. Tesla, although exhibiting similar trends, fared marginally better with a difference of -0.198.

Transitioning to the post-COVID landscape, a noticeable difference is the smoother and relatively stable correlation curves for both tech giants. This could indicate that, post-pandemic, market reactions to these stocks became somewhat more predictable, possibly due to a clearer vision of tech's role in a post-COVID world or increased investor confidence in technology as an industry. One striking observation is Tesla's correlation jump from 0.1 to 0.9 as returns exceed 0.03. While this might initially seem to indicate a strong relationship, it's prudent to treat this spike with caution. Given Tesla's history of high volatility and its status as a relatively younger company, this jump could be attributed to data sparsity or short-term market anomalies.

In essence, while Apple and Tesla offer dynamic diversification potentials, their status as tech stocks implies a need for continuous evaluation and a nuanced approach when incorporating them into risk-reduction strategies.

The impact of the COVID-19 pandemic underscored the intricacies of diversification among various asset classes. Diversification's effectiveness is profoundly influenced by both the asset in focus and global events.

Conclusion

Corn and oil exhibited steady diversification profiles, largely mirroring broader market trends throughout both pre and post-COVID phases. Gold reaffirmed its longstanding role in diversification post-pandemic, capitalizing on market upswings and showcasing resilience during downturns. However, its pre-COVID behaviour revealed potential vulnerabilities.

Property and bonds displayed diverse diversification dynamics, with the post-COVID era emphasizing their correlation with the S&P. Pre-pandemic, bonds showcased potential as diversification tools, while REITs offered limited protection. In equities, tech giants Apple and Tesla presented consistent correlation behaviours across both periods, while Walmart's profile evolved. Notably, the volatility of tech stocks can enhance a portfolio's beta.

For portfolio managers, these insights are instrumental in devising effective investment strategies. Diversification's limited success during the studied periods highlighted gold and bonds as standout diversification assets.

Gold's post-pandemic profile suggests its value during uncertain times, capitalizing on its 'safe-haven' status. Bonds, on the other hand, can be integral during more stable periods. Assets like Apple, Tesla, corn, and oil, despite global disruptions like COVID-19, showcased consistent behaviours, offering portfolio stability. Conversely, assets like gold, bonds, REITs, and Walmart, with their dynamic profiles, demand careful monitoring, offering opportunities for adaptive allocation.

In conclusion, diversification, though foundational in investment, requires agility in its application, especially in the face of black swan events like COVID-19. Portfolio managers should leverage assets adaptively, emphasizing active management in fluctuating financial terrains.