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RESEARCH PAPER

Stock Market Co-Movements between CPEC Economies: A Wavelet based Approach

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ABSTRACT

This research investigates the co-movement of Stock Market Returns between China and Pakistan in the prospective of China Pakistan Economic Corridor. In this study, individual power spectrum, cross and wavelet coherence are used for analyzing co-movement of stock returns between Pakistan and Shanghai at the aggregate level. Wavelet methodology enables the simultaneous examination of the behavior of a time-series in both frequency and time spaces. The daily data for this study is retrieved from the data stream that ranges from January 1, 2007 until May 30, 2022. The wavelet coherence technique reveals that there is strong positive co-movement at the aggregate level in different times, which is a good sign for the investors and policy makers to diversify their investment for getting maximum benefits. The results have an important implication for the fund managers, policy makers, investors and that encourages the portfolio diversification.

KEYWORDS Co-movement, CPEC, Stock Returns, Wavelet Analysis

Introduction

One belt one road initiative is recognized as one of the largest sponsored projects commenced by the Chinese government in 2013 for the restoration of the Silk Road, sustainable growth and economic development. It is one of the global projects of the Chinese Government which connects china with the rest of the world through Maritime Silk Road (MSR), Silk Road Economic Belt (SREB) and the Digital Silk Road (DSR). The president of china Xi Jinping has made this project a game changer for both his domestic strategy and economic policy. The main agenda of one belt one road (OBOR) is to promote multidimensional connectivity among Asia, European Union, Africa and Middle East (Irshad & Xin, 2014). OBOR is comprised of several mega projects but the two main important projects are Maritime Silk Road (MSR) and the Silk Road Economic Belt (SREB). These projects were first made public when the Chinese president visited Indonesia and Kazakhstan in the year 2013. China Pakistan Economic Corridor (CPEC) as a part of OBOR entails billions of investments in networking of road, rail connectivity, energy projects, seaports and manufacturing across Eurasia and Asia. CPEC the project of one belt one road initiative (OBOR) is essential for sustainable growth and economic development (Abednego & Ogunlana, 2006). Therefore, Chinese government investment in CPEC project attracted investors, academicians, fund managers, researchers and policy makers in the financial markets across the countries (Begum, Ashraf, & Muzaffar, 2019) & (Yaseen, Afridi & Muzaffar, 2017).

Pakistan has been an amicable relationship with the Government of China Since its birth. Friendly relationships, between the States united them to launch a new program for economic prosperity that is named as CPEC. It is a unique and smartest project, located in merely one country Pakistan (Menhas et al., 2019). CPEC is one of the six corridors of OBOR

initiative, links the world for economic prosperity and progress. CPEC a worth of 62 billion USD investment of the Chinese Government in different projects of Pakistan for the uplifting the poor infrastructure of the country (Khetran & Saeed, 2017.) This investment package includes 3000 Km road and rail networks that starts from Kashgar in Western China to Gwadar port in Southern Pakistan, fiber optics networks and Special Enterprise Zones (SEZs). The cost of CPEC at the initial stage was projected at about US $ 46 billion but it was later raised to US $ 62billion in 2017 of which 13% was allocated for road 71% for energy, 8% in rail project and 4% for Gwadar port. With the help of CPEC project, the standard of education will be enhanced, health facilities improved and skills of the people will be upgraded in Pakistan (Shaikh et al., 2016) .CPEC will provide better economic opportunities to the landlocked regional states like Uzbekistan, Afghanistan, Tajikistan and Turkmenistan (Martimort & Pouyet, 2015). That is why investors, policy makers and researchers have shown interest about the CPEC investment effects on the co-movement of stock returns between Pakistan and shanghai stock Markets.

CPEC is the potential source for strengthening the regional and global integration. The decreased cost of trade through CPEC routes will enhance the penetration of China into global and regional markets. It is shown by (Zhang et al., 2021) that globalization has synchronized the international financial stock markets. To diversify portfolio investment at the international level the government of China launched CPEC project in Pakistan for getting multifarious benefits in different sectors of the country. (Basdas, 2013) has said that financial integration and sound networking among the countries will remove the linguistic, cultural and social barriers. Thus, after globalization the world market co-movement will cause effects on the implementation of financial policy, evaluation of portfolio risk and in making investment decision.

Inter-connected markets have some considerable benefits, higher flexibility and lower costs. Moreover, in inter-connected market new investors feel hesitation due to their poor structure. It has also been observed that in the inter-connected market prominent economies get attention of the investors and portfolio capital. In addition to this low transaction cost is also one of the benefits in the global assimilation and for securing economic relationships among the countries. These elements in one way or the other will cause positive implication in the stock market activities in the long-run. However, the assimilation among the countries of the world may result economic fragility over time and may prove detrimental at the global level (Baydan, 2015). (Rua & Nunes, 2009) are of the view that there are always lower gains when there is strong co-movement within the assets of portfolio. It means that when the Stock Markets are strongly interconnected there is also high risk of wide spread from one market to an others (Monica & Albu, 2015). In the international interconnected stock market there is no or low portfolio diversification benefits while international segmented market enables the portfolio managers to take benefits from the market diversification (Graham et al., 2013).

The analyzing of Co-movement of Stock Markets in the todays globalized world, plays key role in the financial literature (Mensi et al., 2018).To gain advantages from the portfolio diversification, analyzing co-movement of Stock returns is one of the appropriate techniques both at the national and global level (Dewandaru et al., 2014)**.** Stock market manage discipline in the management through corporate control, allocates funds to the companies for the growth and gives financial assets so the company against inflation (Hirayama & Tsutsui, 2013). Strong integrations within the financial stock markets have mobilized the international investors to search for the new opportunities so that improve adjusted risk returns of their portfolio (Gupta & Guidi, 2012). Since 1990 the economies of the world have been suffered by different economic shocks which resulted the co-movement of the stock returns. CPEC investment in Pakistan is also one of the unusual factors which caused the co-movement of the stock Markets between CPEC countries that are Pakistan and China.

Analyzing Co-movement in the international equity market is used as yardstick for financial integration and economic globalization (Sun et al., 2009). Co-movement is crucial in the international equity market for analyzing the assets allocation, risk management and international portfolio diversification (Graham et al., 2012; Zhou, 2010). When there is strong co-movement at the international stock market there will be no diversification benefits for the investors while international segmented markets give a chance to the portfolio managers to diversify their investment for taking benefits from the markets (Graham et al., 2012). The results of examining the co-movements would help the local, national, international investors and also policy makers to diversify their capital for getting less risk and more gains (Erdogan et al., 2013).

Nevertheless, mostly in past the literature focused time diminution of index returns but ignore the role of frequency- the varying properties of their co-movement. Hence, this research paper contributes to the literature by changing magnetite of equity index returns co-movement using continuous wavelet transform (CWT) in which both time and frequency domain is analyzed. Moreover, we want to ascertain the co- movement of stock returns at the aggregate level between Pakistan and Shanghai stock markets by using wavelet analysis. Our object is to know the co-movement of stock returns of the two countries that are China and Pakistan, that what is level of co-movement between Pakistan and shanghai stock markets before and during the time of CPEC investment.

This study mainly focuses to examine the co-movement of stock returns between Pakistan and Shanghai stock exchange at the aggregate level. The object of this study is to provide insight not only to investors, policy makers and but arbitrageurs who are interested in venturing into relevant subjects. The objective of this study is to measure the co-movement of stock returns between CEPC countries (Pakistan and China) at aggregate level.

The result of this study will give insight to the investors, policy makers and portfolio manager about the variation of stock returns between the CPEC countries i.e. China and Pakistan. This research will give clear path to those investors who want to diversify their investment in different stock markets of CPEC countries i.e. China and Pakistan. It is clear that the investors invest in those market which have maximum volatility stock in the normal periods, while they prefer low volatility in the stock market to remain safe in the period of recession (Bu et al., 2019). Likewise, the investors want to get maximum earning from market where there is strong integration. In interconnected market the investors can get less arbitrage opportunity and face less risk. In volatile market the arbitrage opportunity is maximum, and the risk ratio is also high. Hence, investors will invest in those markets where they find less integration. Usually there are higher frequency trend of co-movement within the stock market in the period of crisis. This type of situation will also enhance the knowledge of investors about the short- and long-term benefits.

Literature Review

International finance is comprised of two main concepts that are financial market integration and stock market co-movement. Financial market integration mechanism enables the market of the country to make an association with other nations and regions. While the concept of co-movement has more association with the international finance. At international level financial market interdependence and linkages have great implication. If an event occur generally in the world particularly in the USA market it will certainly effect the other financial market of the globe (Sheikh et al., 2020).

Aliu and Dehning, (2017) analyzed the automotive industry of the risk and return trade off. They study portfolio optimization theory and tested it through correlation-based method. They concluded that investment in similar sectors did not diversify risk, but the investors still get benefits from the risk and return trade off. Dahir et al. (2018) examined the stock returns and exchange rate correlation through wavelet analysis. They found

positive correlation between conventional stock returns with the exchange rates. Moreover, Jiang et al. (2017) analyzed the effect of global financial crisis upon the conventional equity index over the six countries that are Hong Kong, China Japan, Germany, USA and UK by using the Granger causality test and the vector auto-regression (VAR) model for a sample of equity indices from 2007 to 2009. They concluded that financial crisis was inversely linked with the global equity market, as the financial crisis enhanced global equity market reduced.

Portfolio weighted role in diversified assets allocation can be witnessed in the developing world in the study of (Aliu & Dehning, 2017) in which the returns trade off and risk of automotive industry was examined. In that study correlation-based method was used for testing portfolio optimization theory. They concluded that investment in the similar sector cannot diversify risk still the investors can take benefit from the risk and returns trade off. Mohamed Dahir et al.(2018) analyzed the correlation between the stock returns and exchange rate by using wavelet technique. They found that exchange rate positively correlates with the conventional stock returns. This trend guides the investors that general co-movement in the global stock market slowly adjust with their co-movement and their earning potential is severely affected in the same economies. Al-Yahyaee et al.(2020) tested different types of sectors indices about Islamic and conventional in the s vector auto-regression (VAR) model stock market of USA which include industries, technology, utilities, communication, financial, basic materials, consumer's goods, health care, consumer services financial and energy. They found strong positive correlation among the several sectors indices. While technology, telecommunication, basic material and consumer good services were mostly significant in different time and across the investment horizon.

Further, in one of the other studies wavelet coherence method was used where the local and global trends of stock market of North Africa and Middle East were studied (Graham et al., 2013). In this study it was observed that co-movement of these market varied with time and frequency and strong correlation was witnessed at the time of 2007 crisis. Similarly, coherent method of wavelet analysis has been used for studying the integration between the stock market in pacific region of Asia and the Stock market in the Europe and United States (Loh, 2013). He concluded that thirteen markets in Asia pacific region showed an obvious linkage during the period of recession and also identified that there was high coherence in the subprime recession era as compare to the low scale debt crisis in Europe. Stock market of the Gulf Cooperation council was studied (Akoum et al., 2012). They found that oil price dependence on the stock market was observed on various scales. Moreover, Graham et al.(2013) studied consistency between the emerging market across the world and the market of USA. In this case low frequencies, high consistency was observed, and this trend changed to some extent after 2016 especially when the linkages was observed in the high frequency domain. The relationships among the stock exchange , FTSE100, Nikkei225, Bovespa and DJIA30 were checked through the wavelet technique in which high coherence was found in low frequency region (Madaleno & Pinho, 2012) & (Muzaffar, Shah & Yaseen, (2018).

In addition to that, wavelet based tool was used to examine the systematic risk changes about the Gulf Cooperation council (GCC) and it was found that value at risk (VaR) is more or less intense at higher frequencies (Masih et al., 2010) ; (Benhmad, 2013); (Rahim, Khan & Muzaffar, 2018). studied the co movement of stock market and analyzed the effect of subprime crisis of 2007- 2008. Their study disclosed there are 21various factors which include the condition of the market, local feature determine the dependency strength. Therefore, we try to investigate the neglected issue of stock returns between the CPEC countries where China is an emerging market to fill the gap of relevant literature.

Material and Methods

Data

In this study we used daily time series data from Pakistan and Shanghai Stock Markets over the period of 15 years. The daily data of Morgan Stanley Capital international (MSCI) indices were retrieved from data stream that started from January 1, 2007, until May 30, 2022. Our study period captured the pre-investment and during Chinese investment in Pakistan in the name of CPEC project.

It is pertinent to mention that the said sample period some events occurred in financial point of view. In the year 2008 till 2013 Pakistan has heavily suffered from energy crisis and terrorism. Similarly, the Shanghai Stock Market also collapsed on June 12, 2015, until July 15, 2015. So as a result China lost at about 18 trillion yuan equal to 32% value of shares from its composite indices (Huang & Wang, 2016; Zhao et al., 2019).

Model specification

This data is about Pakistan and Shanghai Stock Market that is computed at the aggregate level by the first differences of the natural logarithm form the daily price indexes and expressed as percentages. The Stock Return formula can be explained as:

$$\boldsymbol{R_t = log\, {p_t}/{p_t}} \qquad (i)$$

Where Rt represents the returns and P indicates index levels at the time t and t − 1. All the holidays that occur due to any reason and the time difference data were missing about the respective stock market stock prices were considered to stay the same that those of the previous day. All the Stock returns are calculated by the first difference of the natural logarithms form of each stock-price index and expressed as percentages.

The Wavelet Approach

Wavelet approach has been developed in the recent past. It is not just used in signal processing, but it has an important role in finance literature. Wavelet approach develops a smooth interrelationship at multi-dimensional-based frequency brand properties. Wavelet approach decomposes data at multi- scales solutions. It gives an appropriate and accurate result apart from standard time series estimators (Ferrer et al., 2016). Furthermore, frequency and scales show an interesting movement like higher frequency (lower scale). This co-movement guides the investors about various scales and frequency ranges (Aguiar-Conraria et al., 2008). Besides, the time and frequency properties of this technique shows the econometric synergy that covers the pitfalls of and structural breaks and error terms (Antonakakis et al., 2018; Yang et al., 2017) . This technique is run by a small wave packet that shows ups and downs over time. This approach calculates and estimates the scale parameters. The wavelet function has been explained as:

$$\boldsymbol{\Psi\, \tau.s(t) = \frac{1}{\sqrt{|s|}} \Psi \left(\frac{T-\tau}{s}\right) s, \tau \in R, s} \qquad (ii)$$

Here "*s*" tells about the parameter length, where τ shows the location of the parameter. Moreover, "*s*" represents the normalization dynamic that causes one-unit wavelet variance and Ψτ,s=1 indicates the relationship between frequency and scales. Moreover, this study Morlet wavelet is used which explains the smoothness, means the (father) and detailed means the (mother) characteristics of the wavelet family. This function is widely used both in economics and finance literature due to its robust practical impacts (Reboredo et al., 2017).

The Continuous Wavelet Transformation (CWT)

Wavelet technique two main parts that are Continuous and Discrete wavelet transformation. Continuous Wavelet Transformation (CWT) is popular and friendly due to

its graphical presentation and simple interpretation (Aguiar-Conraria & Soares, 2011). Continuous Wavelet Transformation (CWT) performs multiresolution-based analysis for dilatation and contraction of wavelet functions whereas Discrete Wavelet Transformation (DWT) is a multiresolution filters-based analysis for re-composition and decomposition of a data.

$$\mathbf{Wx(S)} = \int_{-\infty}^{\infty} \boldsymbol{x}(\boldsymbol{t}) \frac{\mathbf{1}}{\sqrt{\boldsymbol{s}}} \boldsymbol{\Psi}^{*} \left(\frac{\boldsymbol{t}}{\boldsymbol{s}}\right) \qquad \textit{(iii)}$$

Here, Ψ indicates the mother wavelet function and * denotes the function of the complex conjugate. Furthermore, τ represents the translation of the parameter and also S denotes the coherence for the scales of a parameter.

Individual Power Spectrum

A Contour-plot of three dimensional of wavelet power spectra of the Stock Markets Return is explained in the spectrogram. The spectrum explains the local market variance evolution about the time frequency domain, where a larger variance is represented by higher intensity spectra. In individual power spectrum frequency scale is indicated by the vertical axis while the time scale is indicated on the horizontal axis. At the same time the intensity is shown in the form of color where blue color indicates low while yellow color shows high intensity. This explanation guides us that on the horizontal-axis (when wavelet scaling is kept constant) and one studies the variation in intensity over timescale, whereas, down the vertical-axis (when the time scale is kept constant), one studies the variation in intensity over the wavelet-scale. The null hypothesis of a steady operation is compared with WP spectrum to determine the statistical significance of the WP which is achieved by Monte-Carlo simulations through a phase randomized surrogate series (Grinsted et al., 2004; Keim & Percival, 2015; Loh, 2013; Rua & Nunes, 2009). Hardy black contour represents 5 % `significance level in the wavelet power spectrum. These edge effects impact the transform, and the region of this impact is termed as cone of influence (COI) that is explain that the results of the particular region are unreliable (Torrence & Compo, 1998). The lighter shade of the cone of influence separate the region of high intensity area from the region of the low intensity region.

Cross wavelet transformation (XWT)

In addition, Cross Wavelet Transform (XWT) analysis is used for observing the local similarities. In XWT fewer numbers of parameters are required so that normal and abnormal classes are distinguished. Moreover, this technique has the ability to deal with noisy environments and produce more authentic results (Banerjee & Mitra, 2014) . At the same time, it keeps the detailed information about trough which imaginary part of input can be handled without losing the absolute function. In the spectrogram the figure uses color codes for power spectrum or strength of correlations, ranging from blue (low correlations) to red (high correlations). When the vector arrows point to the right means, it means that the indexes are in phase (positive correlation), however, when they pointing to the left, it suggests that the indexes are out of phase (negative correlation). Subsequently, the vector arrows pointing to the right and down means that the first series is leading, whereas if they point to right and up, it means that the second series is leading, vice versa (Madaleno & Pinho, 2010).

Wavelet Coherence (WCOH)

Wavelet coherence is term as the coefficient of localized correlation in respect of time and frequency domain. WCOH is used for extraction of characteristics features at the time of localized similarities. To achieve great accuracy in high level of noise. The results of wavelet coherence are comparatively good even though if it is not applied on the base line

correction. That is the reason wavelet coherence technique is applied for determining the time frequency interaction of different countries.

Moreover, wavelet coherence transforms (WCT) are more often used to analyze the dependency between two-time series data. These approach are more appropriate because of its time and frequency characteristics (Reboredo et al., 2017).(Aguiar-Conraria et al., 2008) discloses that WCT as the ratio of the cross-spectrum to the spectrum element of each series can be considered as the spatial similarity (both in frequency and time) between two series. This is indicated as the coefficient of time-frequency space correlation.

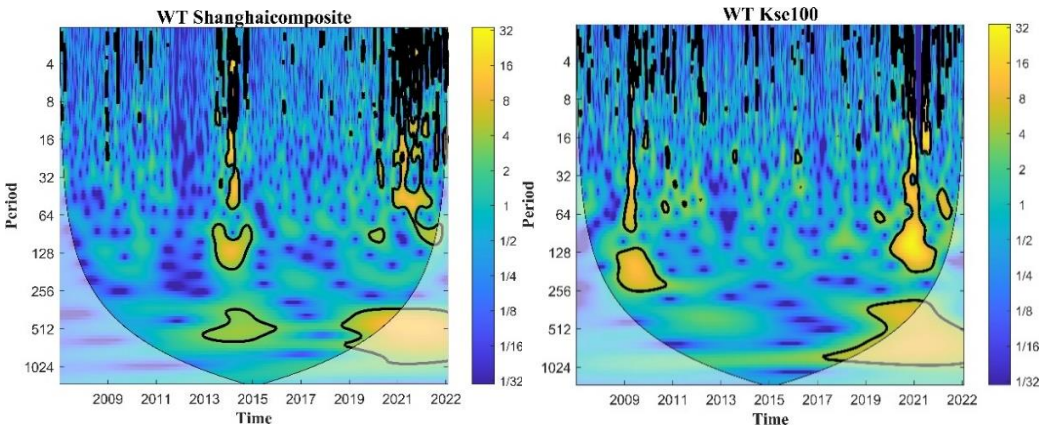
Above all wavelet coherence is represented by the color codes that are blue to yellow means low coherency to high coherency. Low level coherence shows week correlation while high correlation represents strong correlation. The arrows in the spectrogram indicates the phase information where both the right and left direction show that the relations between the two variables are in phase (positive relationship) while the arrows right down show that they are in phase but with the leading effect (that Pakistan Stock Market have positive influence on the Shanghai Stock Market. The wavelet coherence can be defined as

$$Rn^2(S) = \frac{|S(s-1W^x/yn(s)^2}{S(s-1|Wn(s)S(s-1|(wn(s)^y|2} \qquad (iv)$$

Where, R2 indicates the coherence of wavelets and S is a smoothing operator. The value range of WCT is 0 to 1. WCT is an appropriate technique for analyzing co-movement between two markets or indexes. No other techniques could show a latitudinal relationship between the two-time series co-efficient in frequency and time domain properties previously. WCT can be expressed in the same way as the coefficient of correlation. When the value of WCT is near 1, it indicates that there is a strong dependency that exists between the two markets or indexes. On the other hand, a lower dependency is shown when the value of CWT is close to 0. Meaning that higher variation indicates a large wavelet power spectrum. Though the coefficient of correlation is statistically significant, WCT is estimated using simulation from Monte Carlo wavelet analysis (Torrence & Compo, 1998).

Results and Discussion

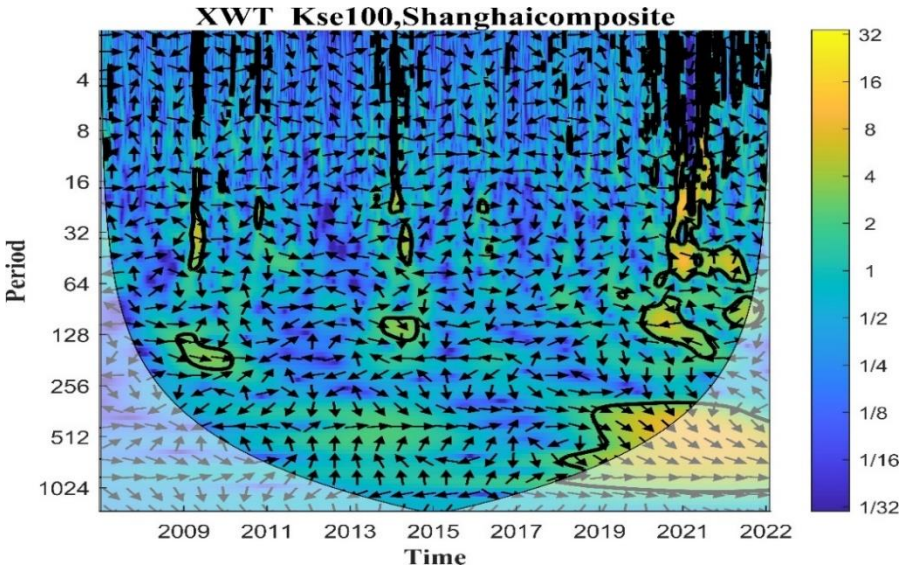
ndividual power spectrum of Pakistan and Shanghai Stock Markets



In these spectra there exists some similarities in the low frequency WP concentration as compare to the high frequency scale. In the low frequency the spectra of both the counties are localized in most of the time while high intensity can be seen in low frequency (64-256) in Shanghai Stock Market (Shanghai Composite) in year of (2013-2015) and in (2000-2021). whereas in Pakistan Stock Market (KSE 100) high intensity can be seen in low frequency (64-256) in the year of (2009-2011) and in (2000-2022). In the medium scale (256-512) high intensity can be seen in the year of (2013- 2015) and in (2019-2020)

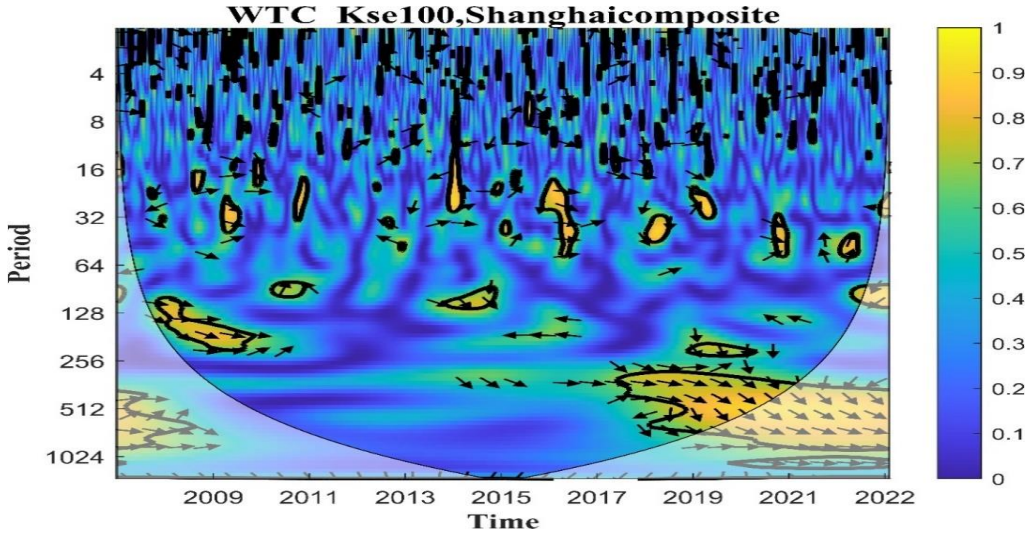
in the Shanghai Stock market. Similarly, high intensity can be seen in medium scale (256-512) in Pakistan Stock Market in the (2019-2000). At the same time at the high scale (512-1024) the Stock Markets returns of Pakistan and shanghai are localized with high intensity in different periods. In the high scale (512-1024) Shanghai Stock Exchange showed high intensity in the year of (2019-2000) while high intensity is shown in Pakistan Stock Exchange in the year of (2018-2021).

Cross Wavelet Transformation Pakistan VS Shanghai Stock Markets



In case of Pakistan and Shanghai Stock Markets spectrogram the highest level of covariance is observed in low scale (32-256) in the year of (2009-2010) and in the year of (2020-2021). It is observed that in low scale (32-256) the arrows are in phase. It means there is positive relationship between the two Stock Markets of Pakistan and china in the year of (2009-2010) and Pakistan Stock Market is leading, and Shanghai Stock Market is legging. While at the high scale (256-1024) Pakistan and Shanghai Stock Markets are in phase means that have positive relationship and the arrows are right down which shows China Stock Market (Shanghai Stock Market) is leading and Pakistan Stock Market is legging. In the year of (2000-2022) the Pakistan Economy was badly affected by the COVID 19 which slowed down the economy of Pakistan.

Wavelet coherence: Pakistan VS Shanghai Stock Markets



The computed result of wavelet coherence for stock returns about Pakistan and Shanghai Stock Markets is presented in this wavelet coherence spectrograms. The theory of convergence of stock price indices across sectors of Pakistan and China cannot be ignored if large in-phase co-movements are found in the stock returns of both countries. The intensity of wavelet coherence is presented in the form of color coding that goes from blue to yellow which indicates low frequency to high frequency. This means that low frequency shows week relation while high frequency represents strong relationship. In this spectrogram the arrow indicates the phase information where right (left) direction mean in-phase (anti- phase) variables. One can see that the region of WCOH represents the region of significance

The total time span of this spectrogram is divided into three phases. The first starts from (2007 2013) the second parts commence from the year 2013-2017 and third phase can be counted from the year (2017-2022). In first phase Pakistan and Shanghai stock Markets showed strong low frequency co-movement in all the years except in the low scale of 2009, 2017 and 2019. While in the medium scale (256-512) there is high correlation between the Pakistan and Shanghai Stock Market in the year of (2017-2021). Similarly, in the third phase high level scale (512-1024) of correlation is observed in the year of (2000-2021).

It shall also be noted that most of these phase information (almost majority) represents in-phase stock returns (right turn arrows) which means that the stock returns of Pakistan Stock Market with that of Shanghai Stock Market are in-phase with a leading effect (KSE 100 stock market has a positive causal influence on the Shanghai Stock Market). Moreover, financial integration and globalization is the retiring trend to stimulate further global connectedness.

This research analyses co-movement of stock returns of Pakistan Stock Market and shanghai Stock Market at the aggregate level by using the wavelet coherence approach. The color codes in this study plays an important role in explaining the results. Wavelet power in the spectrogram is given by the colors that varies from deep blue means the highest and light blue means the lowest the dark deep red color measures the higher-level of co-movement and the dark blue color measures the lowest level of coherence (co-movement). Moreover, the span of the study can be decomposed into various scales and frequencies. The lower scales show the higher frequency while the higher scales indicate the lower frequency. The horizontal axis indicates the study period that starts from 1 January, 2007 to 30 may, 2022. Similarly, another feature of the graph is its frequency with which events occur. The frequency element is shown on the vertical line, which consist of the daily units and that ranges from 4 to 512 days in length. Further, the time span can be divided into various holding periods that are short term (2–256), mid-range (256-512) and long term (512-1024). A color component tells that how near the two indices move along. However, the black cantors designate the area where the wavelet power is statistically significant at 5 % (Aguiar-Conraria & Soares, 2011). The significant level is determined through Monto Carlo simulations and depicted as black contours. Likewise, lead-leg phase relationships within the variables are represented through arrows in the wavelet coherence plot. When the two series are in phase that demonstrate that move in the same directions while if the two arrows are anti phase, they tell that they move in opposite direction. Similarly, the right down and left up arrows demonstrate the leading role of the first variable whereas right up and left down arrows indicates the leading role of the second variable. When the vector arrows are stand to the right and point down, this indicates that the second variable is in a leading position and vice versa (Madaleno & Pinho, 2010).

Conclusion

The assessment of Pakistan and Shanghai Stock Returns Co-Movement at the aggregate level shed light on the potential advantages of portfolio diversification. This

research paper gives a new insight about the Co-movement measurement of Stock returns by applying the wavelet approach. Wavelet analysis asses the time and frequency varying components within unified framework. This research paper creates interest for the investors because of the co-movement variation with respect of time both in long and short term.

This research was designed to examine the co-movement of Pakistan and Shanghai Stock Markets indices at the aggregate level. In the present study we use daily data that cover over 15 years, starting from January 1, 2007 until May 30, 2022. In this research paper econometric technique wavelet coherence was used for drawing the conclusion. It this paper we claim that wavelet technique is better than the Fourier transformation and is best suited for handling with the financial data. One of the advantages of the wavelet transformation is that it can examine transient dynamics for a single time series and can also be used for the association between two time series.

Moreover, this research paper gives new look to the co-movement and lead- leg relationship between Pakistan and shanghai stock exchange at the aggregate for 2007-2022. To examine the issue of co-movement in detail, this study has decomposed the time and frequency relationship within the aggregate returns by using continuous wavelet technique. Hence, we can examine the coherency of KSE 100 and shanghai stock exchange at the aggregate level and lead- leg relationship at different frequencies over the specific span of time.

The researcher recommends that this study has numerous limitations. First, in this research the researcher examines the co-movement of stock returns between CPEC countries that are China and Pakistan prior and during the Chinese government investment in Pakistan but ignores the rest of the countries that are the part of China Pakistan Economic Corridor. Second, although, continuous wavelet analysis gives detail picture of lead leg relationship and the co-movement between aggregate returns but still the magnitude of impact of the leading country is unknown. Similarly, our study is limited to analyze the Co-movement between Pakistan Stock Exchange and Shanghai Stock Exchange, but it has ignored the Shenzhen Stock Exchange of China which is also one of the important stock exchanges of China. Besides this the researcher does not examines the cross-variation co-movements of stock returns between the various sectors of CPEC countries.

Above all the assessment of co-movement of stock returns between the two CPEC countries that are China and Pakistan is essential for knowing the international portfolio diversification and potential benefits at the aggregate level. This analysis has more attraction for the investors in regard of co- movement of stock returns both short- and long-term investment that is frequency domain. With the help of wavelet analysis one can keep into consideration the time and frequency domains simultaneously.

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