Are the ASEAN stock markets integrated with the US market ? new evidence from wavelet coherence

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Are the ASEAN stock markets integrated with the US market ? new evidence from wavelet coherence

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Abstract

It is generally believed that the US subprime crisis affected the ASEAN stock markets heavily. The main purpose of this paper is to look at the effects and performance of the stock markets of the big three ASEAN member countries such as Singapore, Malaysia and Indonesia against the influence of a larger economy such as, the United States. The method considered appropriate for the analysis is wavelet coherence. The findings tend to indicate that the co-movements between all these stock markets change significantly over time and across frequencies. We find that there is a strong coherence between the US stock market and the Singaporean, Malaysian and Indonesian stock markets. Furthermore, we find that there is a strong coherence between Singaporean and Malaysian markets in the long term. The results are intuitive and plausible with strong policy implications.

Keywords: market integration, ASEAN, USA, wavelet coherence

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1.0 INTRODUCTION

The ASEAN stock performance has been greatly affected by financial crisis globally. The Asian financial crisis in the 1990s that started with major currency alignment in Thailand has led to serious repercussions on the corporate and the financial sectors in Thailand. To some extent it caused corporate failures and bankruptcies. The spill-over effect had not only affected the neighbouring countries but also had gone as far as Latin America.

The subprime financial crisis and the credit bubble in the United States also impacted several economies around the world. And ASEAN economies are no exception. Therefore, it is the intent of this paper to look at the effects and performance of the big three ASEAN member countries such as Singapore, Malaysia and Indonesia against the influence of a larger economy such as, the United States.

In globalized financial markets with growing trading volumes and liquidity, the integration and co-movements were becoming stronger in time. Therefore, examination and research on different types of co-movements and correlations in financial series is of great importance. In addition to the time dimension of the market dynamics, there are many different factors affecting the market dynamics.

There are different types of investors in the market and their behavior affects the market. They are traders that create 'noises' in the market with a shorter interval investment horizon to corporate and fund managers with different risk appetite and longer time horizon. The intention of this paper therefore is to study the performance and behavior of stock indices of Singapore, Malaysia and Indonesia against the stock market of the United States.

2.0   METHODOLOGY

In this paper we have used the wavelet coherence method to analyse the stock indices. Wavelet coherence measures the local correlation of two time series in the time-frequency domain. We define the wavelet coherence as follows:

$$R^2(u,s) \;=\; \frac{|S(s^{-1}W_{xy}(u,s)|^2}{S(s^{-1}|W_x(u,s)|^2)\, S(s^{-1}|W_y(u,s)|^2)}$$

the wavelet coherence as the square of the absolute value of the smooth wavelet spectra, and normalized by the product of the smoothed individual poser spectra of each series.

Thus this will provide a useful tool for the analysis of co-movement across the stock markets. The phase difference, indicated by arrows, gives us details about delays of oscillation of the two examined time series. Arrows pointing to the right (left) when the time series are in-phase (anti-phase) or are positively (negatively) correlated. Arrows pointing up mean that the second time series leads the first one, arrows pointing down indicate that the first time series leads the second one.

3.0   RESULTS AND DISCUSSIONS

In this analysis, data is collected for the index of United States Stock Index, Malaysian Stock Index, Singapore Stock Index and The Indonesian Stock Index. And all these indices will be compared against the Unites States Stock Index.

The data were obtained from World Bank website. We have converted the data in Logarithmic Form and uses the price2ret command in MATLAB to convert any given series to return based series. The following are the plots of the targeted indices and their corresponding stock returns.
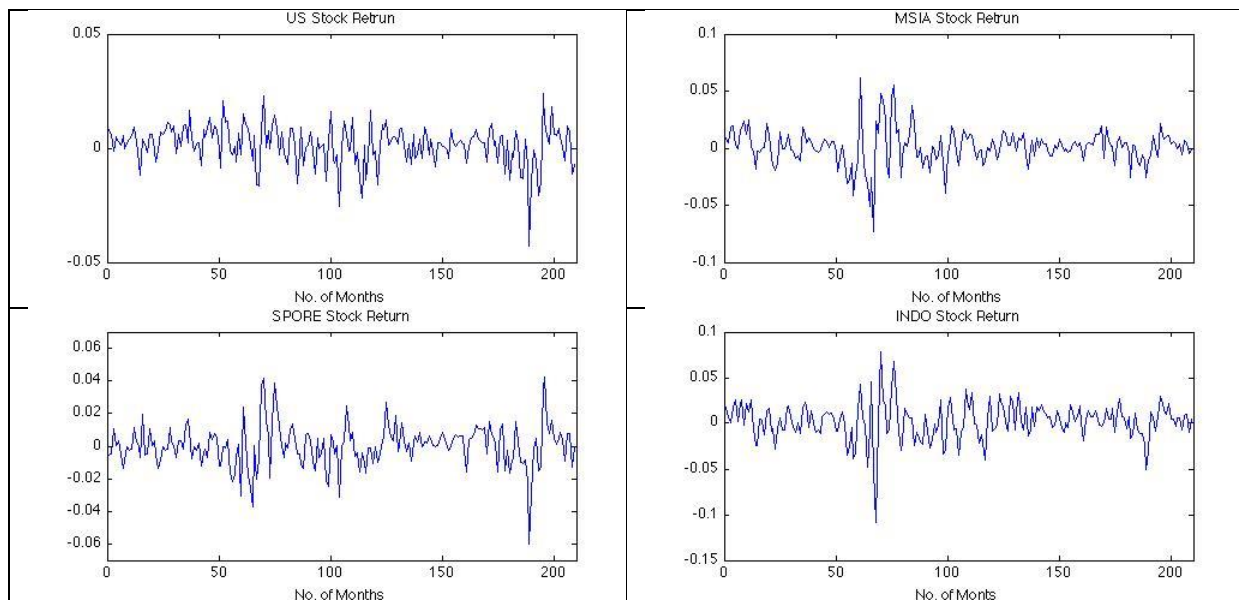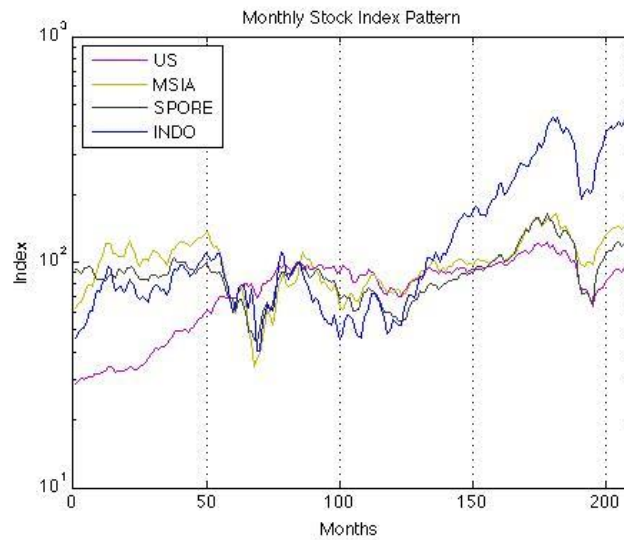
In our analysis, we utilize the wavelet transform to analyze the time-scale properties of stock returns. Moreover, the main analysis of co movement of the studied stock markets is the wavelet coherence as it allows quantifying the relation between two time series in the time-frequency domain.

The CWT expands the time series into time frequency space.
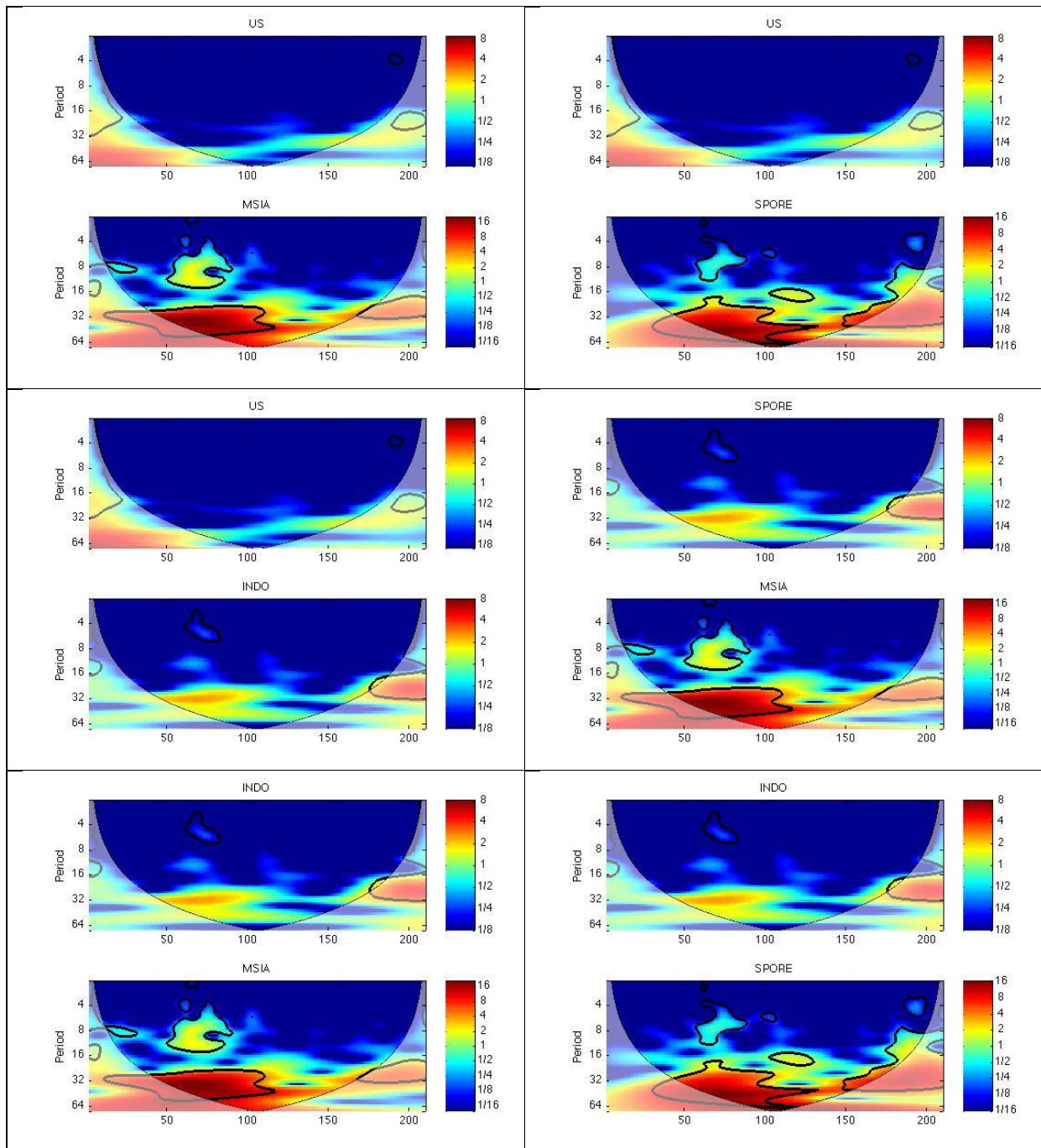
The XWT finds regions in time frequency space where the time series show high common power.
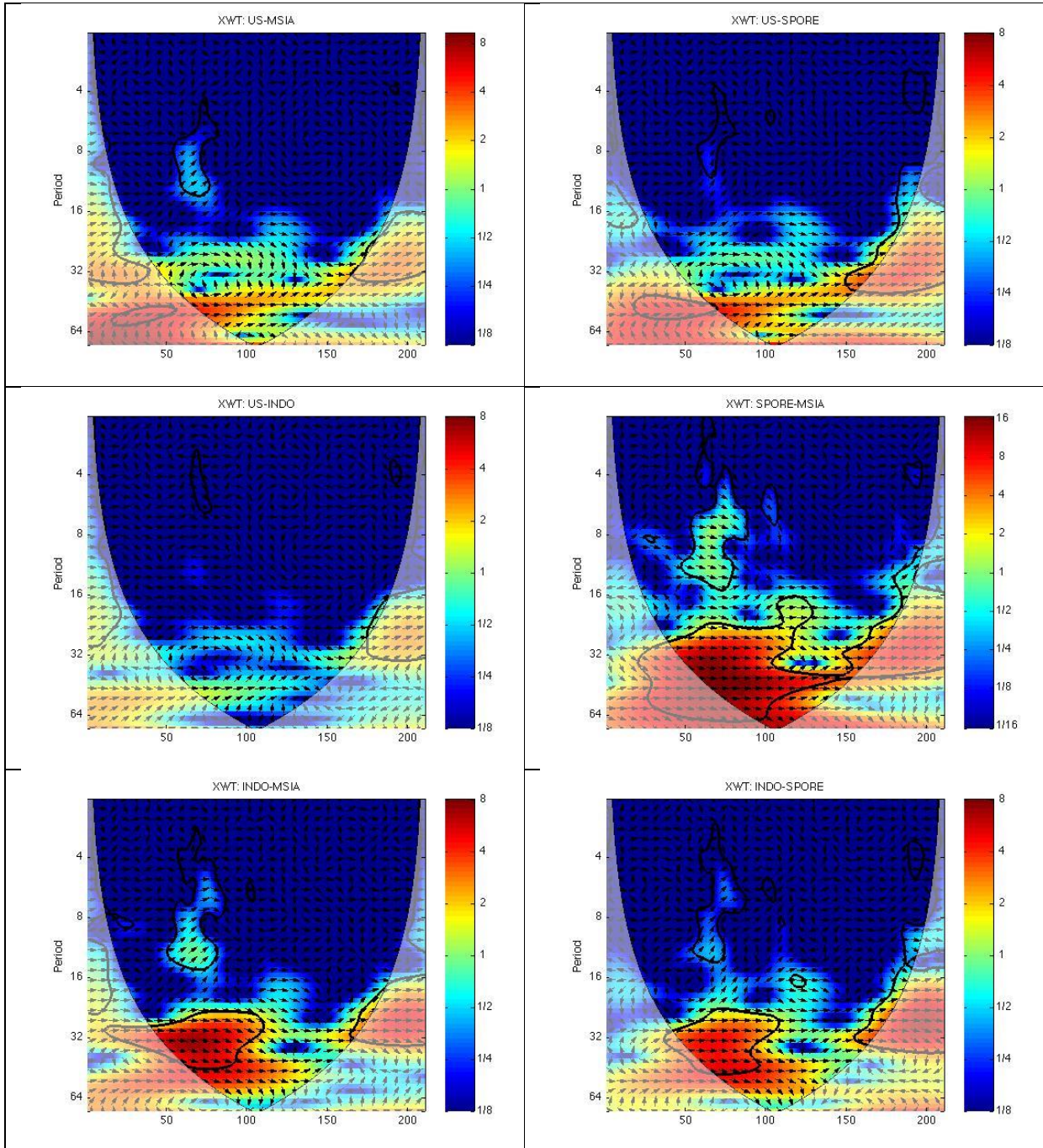
We use Monte Carlo Simulations to assess the statistical significance of the wavelet coherence. Figure below shows the estimated wavelet coherency and the phase difference for all examined pairs of indices. Time is on the horizontal axis, while vertical axis refers to frequency (the lower the frequency, the higher the scale, or period).

The wavelet coherence finds the regions in time frequency space where the two time series co-vary (but do not necessarily have high power). Significant dependence can be found on the plot by looking at the warmer colors. The colder the color, the less dependent the series are. Blue regions represent periods and frequencies with no dependence in the indices. Thus the plot clearly identifies both frequency bands and time intervals where the series move together.

We can see that all the figures below show very strong coherence or dependence from each local stock to that of the united states. Since the warmer colors are reflecting dependence, we can conclude that all the three markets in Asia are greatly influenced by the US stock market.

Looking at the WTC: US-MSIA wavelet transform coherence diagram, we can notice that the arrows are mostly pointing upwards in the warm regions. This shows that the US market index is always leading the behavior of the Malaysian Stock market behavior. This insight is very important in discovering new information not yet discovered by other techniques.

Looking at the WTC: US-SPORE wavelet transform coherence diagram, we can notice that the arrows are mostly pointing upwards in the warm regions. This shows that the US market index is always leading the behavior of the Singapore Stock market behavior. Prior to the 150th month, it is less dependent but toward the financial crisis period in the United States, we can notice a very strong coherence in low as well as high period interval.

Looking at the WTC: US-INDO wavelet transform coherence diagram, there is no dependence in the long-term or higher period time scale. The Coherence happens in the middle range period and the arrows are pointing eastwards. This phase difference shows the delayed reaction towards the coherence

Looking at the WTC: SPORE-MSIA wavelet transform coherence diagram, at the higher scale, there is a strong coherence in the 32 to 60 period and this happens throughout the 200 month period. This shows a strong trade relation between the two countries.

Looking at the WTC: INDO-MSIA wavelet transform coherence diagram, there is strong coherence in the 16 to 32 period scales throughout the 200 months. This reflects strong trade and economic links between the countries. The arrows in this region show that Indonesia stock market is lagging the Malaysian stock market.

Looking at the WTC: INDO-SPORE wavelet transform coherence diagram, there is strong coherence in the 32 period scale and the arrows shows the INDO stock market is lagging the SPORE stock market in the long-term. However, in the short term the dependence and coherence are mixed.

The WTC finds regions in time frequency space where the two time series co-vary (but does not necessarily have high power).
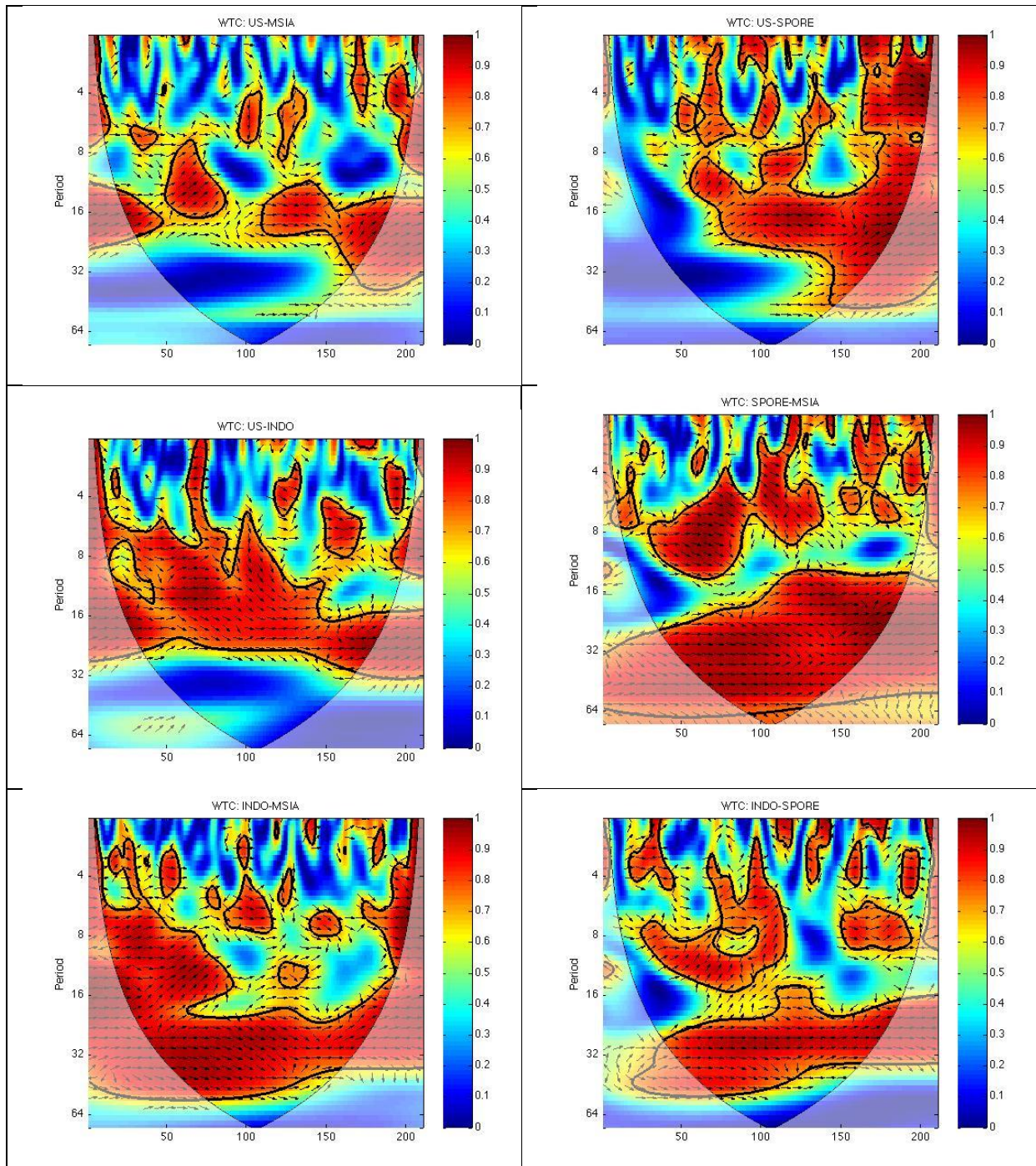
4.0   CONCLUSION

In this paper, we contribute to the literature on the ASEAN stock market co-movement and contagion by researching the interconnections between US stock markets in time-frequency space. The novelty of this approach lies in the usage of the wavelet tools to high-frequency financial market data, which allows understanding the relationship between stock market returns in completely different way. In our research, we combine both time and frequency domain and we apply the cross-wavelet analysis as a main tool of studying the co-movements. Using the wavelet coherence, we show how cross-correlations are changing over time and across frequencies, continuously.

The main result of our analysis is that we find that interconnection between all stock markets changes significantly in time and varies across frequencies. We find that there is a strong coherence between the US stock market and the MSIA, SPORE and the INDO stock markets. We also find that there is a strong coherence between MSIA and SPORE in the long term.

INDO has both strong coherence between MSIA and SPORE. This reflects the strong economic relation between the countries. This dynamics of interdependence visible from the wavelet coherence of high- frequency data is unique and allows us to understand the relationship between analyzed stock markets in a new way. To conclude, we have shown very interesting dynamics of cross-correlations between US stock market and Asian stock markets using a novel approach. It is hoped that this finding will shed some light in providing a possibility of the new approach to financial risk modeling. Thus, the findings have strong implications for portfolio management.

REFERENCES

Caraiani, P., (2012) Money and output: New evidence based on wavelet coherence. *Economics Letters*, 116(3), 547-550

Dahir, A. M., Mahat, F., Hisyam, N., Bany-Ariffin, A.N. (2018), Revisiting the dynamic relationship between exchange rates and stock prices in BRICS countries: A wavelet analysis, *Borsa Istanbul Review*, 18(2), 101 -113

Dewandaru, G., Masih, R. and Masih, M. (2016), Contagion and Interdependence across Asia-Pacific Equity Markets: An Analysis Based on Multi-Horizon Discrete and Continuous Wavelet Transformations, *International Review of Economics and Finance*, 43, 363 -377

Dewandaru, G, Masih, R. and Masih, M. (2016), What Can Wavelets Unveil About the Vulnerabilities of Monetary Integration? A Tale of Eurozone Stock Markets, *Economic Modelling*, 52, 981 - 996

Masih, M., Alzahrani, M. and Al-Titi, O. (2010), Systematic Risk and Time Scales : New Evidence from an Application of Wavelet Approach to the Emerging Gulf Stock Markets, *International Review of Financial Analysis*, 19 (1), 10 – 18

Ramsey, J. and Lampart, C., (1998), Decomposition of economic relationships by timescale using wavelets, *Macroeconomic Dynamics* , 2(1), 49-71.

Saiti, B., Bacha, O.I. and Masih, M. (2016), Testing the Conventional and Islamic Financial Market Contagion: Evidence from Wavelet Analysis, *Emerging Markets Finance and Trade*, 52(8), 1832 -1849

Schleicher, C. (2002), An Introduction to Wavelets for Economists, Bank of Canada, Staff Working Paper, No. 2002 -3

Tiwari, A. Mutascu, M. and Andries, A., (2013), Decomposing time-frequency relationship between producer price and consumer price indices in Romania through wavelet analysis. *Economic Modelling,* 31(19), 151-159.

Tsai, S.L. and Chang, T. (2018), The Comovement between Money and Economic Growth in 15 AsiaPacific Countries: Wavelet Coherency Analysis in Time Frequency Domain, *Romanian Journal of Economic Forecasting,* 21(2), 63 -78