Co-Movements of Various Indices' Prices in Bear and Bull Periods: Portfolio Diversification Implications

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Abstract

Portfolio diversification is investors' crucial action to avoid negative market conditions or to gain more benefits from positive market conditions. Especially derivative instruments clung to various indices may cause negative returns during bear periods if required diversification is not provided on portfolio, and on the other hand, these instruments may cause to inadequately utilize from bull periods if the structure of a portfolio is not established well. Hence, in this study, to utilize the benefits from international portfolio diversification, certain international stock markets co-movements are investigated during three periods by using principal component analysis, and various portfolio diversification implications are generated after this empirical study. These periods are defined respectively a bear period which includes mortgage crises in 2008, a bull period as second period representing after the mortgage crises, a relatively bull period as third period representing the end of huge money supply to the market.

Keywords: *index co-movement, portfolio diversification, principal component analysis*

Çeşitli Endeks Fiyatlarının, Ayı ve Boğa Piyasası Dönemlerindeki Birlikte Hareketleri: Portföy Çeşitlendirmesi Önerileri

Öz

Portföy çeşitlendirmesi, dönemine göre düşüşte olan sermaye piyasası durumlarından kaçınmak ve yükselişte olan dönemlerdeki pozitif havadan daha fazla yararlanmak için, yatırımcıların çalışmalarında önem arz eder. Eğer gerekli portföy çeşitlendirmesi, bir portföyde sağlanmazsa, özellikle endekse bağlı türev araçlar, ayı piyasalarında negatif getiriye sebep olabilirler. Bununla birlikte, eğer portföy yapısı yeteri kadar iyi oluşturulmamışsa, boğa piyasası dönemlerindeki fiyat yükselişi trendinden yeterince yararlanılamayabilir. Bu yüzden, bu çalışmada, uluslararası portföy çeşitlendirmesinin getirilerinden faydalanabilmek için, belirli hisse senedi piyasası endeksleri, temel bileşenler analizi kullanılarak, üç farklı dönemde incelenmiş ve bu ampirik çalışmanın ardından çeşitli portföy çeşitlendirmesi önerilerinde bulunulmuştur. Bu üç dönem sırasıyla, 2008 yılı mortgage krizini içeren ayı piyasası, kriz sonrası dönemdeki boğa piyasası ve büyük para arzı döneminin sonu kabul edilen göreceli boğa piyasasıdır.

Anahtar Kelimeler: *endeks birlikte hareketi, portföy çeşitlendirmesi, temel bileşenler analizi*

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1. Introduction & Literature Review

Many studies in the recent past have demonstrated the growing importance of stock market co-movements as an outcome of increased economic globalization (Dewandaru et al., 2014, pp 554). Investigating co-movements between stock markets is a widely debate issue and in order to utilize the benefits from international portfolio diversification, international stock markets co-movements have been investigated in a series of studies (Bonfiglioli et al., 2005, pp 1300-1301). On the other hand, contagions and correlations between assets for international investors are important opportunities to utilize the benefits from diversification (Alaoui et al., 2014, pp 54). Thus, in this paper, the co-movement of the various stock indices has been investigated during defined bear and bull periods, and some portfolio diversification implications have been defined with regard to co-movements' results. Specifically, three period is defined between 2007 and 2016 as bear, bull and relatively-bull for defined stock indices, and co-movements of these stock indices have been investigated by using principal component analysis (PCA). Additionally, previous portfolio diversification implication studies are based on different periods which are covering various crisis and bull eras in literature. In this study, not only crisis and bull periods are considered but also relatively bull period is taken into analysis. On the other hand, this study is covering periods between the Mortgage crisis and end of 2016 year which may be accepted as wider and more updated than other studies in literature.

For the literature in the co-movement of stocks, Mazouz, Mohamed and and Saadouni (2016, pp 52-53) used univariate analysis on Dow Jones Islamic Market World Index (DJIMWI) in order to find the co-movements of index revisions such as a newly added stock or deleted stock with index and they found that a stock's co-movement with the DJIMWI increases when it joins into the index and decreases when it is deleted from the index. Additionally, they found that the co-movement of newly added stocks with current existing DJIMWI stocks increases during the month of Ramadan and during high trading activity periods; whereas, decreases if it is deleted.

In Alaoui, Dewandaru, Rosly and Masih's empiric study (2014, pp 58-59), by using wavelet techniques (discrete and continuous), the co-movement dynamics is investigated at different time scales or horizons of Islamic Dubai Financial Market (DFM-UAE) index returns with their counterpart regional Islamic indices returns such as GCC index, ASEAN index, Developing Countries index, Emerging Countries Index, and the Global Sukuk. They found that the two markets DFM UAE, and (GCC and Saudi) are converging, in the long run, to the same level of risk and volatility with the Global Sukuk index. Closer markets tend to suggest a contagion effect showing higher correlation and higher interdependence with a certain time delay.

By using wavelet approach, Chen, Chen and Tseng (2017, pp 490) investigated the co-movements of returns in the health care sectors from the US, UK and Germany stock markets over the period of 1992-2012 and they found that the return of the health care sector in the UK (US) stock market leads those in the US and Germany (Germany) stock markets in the short run and medium run, while the returns of the health care sector in the US stock market lead those in the UK stock market in the long run.

Bonfiglioli and Favero (2005, pp 1305) studied long-term interdependence, and short-term contagion and interdependence between US and German stock markets with regard to effects of fluctuations of US shares on German stocks by using co-integration analysis and vector error correction model. They found that the effect of fluctuations of US stock market on German stock market has a non-linear dynamic and normal fluctuations in the US stock market have no effect on German market. Additionally, they claimed that their findings have remarkable implications for international portfolio diversification.

In Meric, Ratner and G.Meric's empirical study (2008, pp 159-160), the co-movement of sector index returns in the world's major stock markets is investigated in order to provide successful portfolio diversification implications by using principal component analysis and Granger causality test. In this paper, principal component analysis is used and the paper is referenced from Meric et al. (2008, pp 156-177) study. Moreover, portfolio diversification is cited after investigation of daily closing prices of various indices.

2. Data

Daily closing prices of various indices from chosen countries are drawn from Thomson Reuters database. Indices for this benchmark are the "S&P 500 Index", the "NASDAQ 100" and the "DOW JONES 30" for the USA, and the "BOVESPA" for Brazil, and the "BIST 100" for Turkey, and the "CAC 40" for France, and the "DAX" for Germany, and the "EURO STOXX" for European Union, and the "FTSE 100" for the UK, and the "HANG SENG" for Hong Kong, and the "IBEX 35" for Spain, and the "KOREA KOSPI" for South Korea, and the "NIFTY 50" for India, and the "RTS Industry" for Russia. In this way, three indices for North America, one index for South America, five indices for Europe, and four indices for Asia are selected in order to make the study as more global.

Three different time interval are defined for the co-movement study. It is defined by investigating and referencing the "S&P 500" daily returns for almost ten years era. Specifically, the sample is separated into three periods; the first period is from the first decline attempt of S&P to the lowest price of S&P index (10th of October, 2007 – 2nd of February, 2009); the second period is from 3rd of February, 2009 to end of 2012; the third period is from the beginning of the year 2013 to end of 2016. Herewith, the first period is called as "bear market"; the second period is called "bull market" and the third period is called "relatively bull market". By dividing the sample into three periods, this study is aiming to define the factors of the global market as leader indices and follower indices, and also compare the results according to changing dynamics of the global stock market. Although it is obvious that it is hard to assume these almost three year periods as exact bull or bear market, the 2008 mortgage crisis era and afterwards the money expansion eras from 2009 to 2016 are accepted as bear and bull market respectively due to indices' decline and incline dynamics.

Common daily closing prices are used for study. In other words, only common trading days for various indices are extracted and applied on study. Non-common trading days are eliminated from study. Therefore, it means that for the first period (10.10.2007-02.02.2009), 247 trading daily prices are used, and for the second period (03.02.2009-28.12.2012), 785 trading daily prices are used, and for the third period (08.01.2013-29.12.2016) 799 trading daily prices are used for this empiric benchmark.

3. Methodology

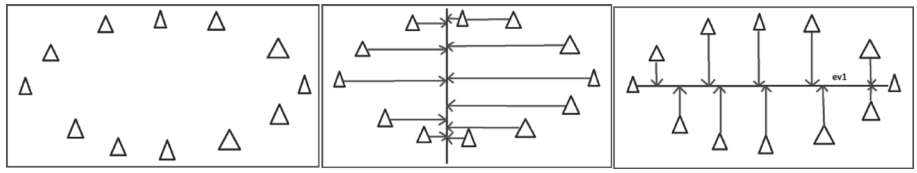
The principal component analysis, which is a technique developed by Mardia, Kent and Bibby (1979, pp 313-325) and literally used for emphasizing variation and bringing out strong patterns in a dataset, may be used for studying the co-movements of index returns and therefore, these co-movement information may be used for portfolio diversification studies and various economic researches. The principal component analysis technique with Varimax rotation method is applied to three periods which are bear, bull and relatively-bull on IBM SPSS program.

The principal components are the directions where there is the most variance, the directions where the data is most spread out. In order to explain in an easiest manner as an additional information of Mardia's theory, there are some graphics below:

Table 1. Data Study Periods

	Beginning of Period	End of Period	Common Trading Days
Bear Period	October 10, 2007	February 2, 2009	247
Bull Period	February 3, 2009	December 28, 2012	785
Relatively Bull Period	January 8, 2013	December 29, 2016	799

Graph 1. Principal Component Analysis: Graphic Explanation



There are some triangles in the shape of an oval in first graph. Imagine that the triangles are points of data. To find the direction where there is most variance, find the straight line where the data is most spread out when projected onto it. Second graph is indicating that vertical straight line with the points projected on to it. The data is not very spread out in second graph, therefore it does not have a large variance. It is probably not the principal component. In the third graph, on this line the data is way more spread out, it has a large variance. In fact there is not a straight line you can draw that has a larger variance than a horizontal one. A horizontal line is therefore the principal component in this example (Information Engineer, georgemdallas.wordpress.com, 2013). In this study, principal component analysis is used due to the fact that the data set could be implemented more easily on study compared to wavelet techniques and univariate analysis which were used in other studies such as Mazous et al. (2016) and Alaoui et al. (2014) On the other hand, IBM SPSS is providing various PCA tests in literature for these kind of studies which are trying to find principal components in a dataset.

4. Empirical Results

The daily closing prices of the fourteen indices are used as inputs in the principal component analysis (PCA) by grouping the indices according to their similarities of their movements. Instead of direct oblimin, the varimax rotation is implemented in order to maximize the factor loadings of the various indices in each principal component with similar movement patterns and also statistically significant components with eigen values greater than unity, which is Kaiser's rule, are retained for analysis (Meric et al., 2008).

In the same principal component, the indices with high factor loadings move closely together and according to Meric, Ratner and Gulser's study in 2008, it is not beneficial for good portfolio diversification to investors. On the other hand, it gives some clues about investigating the global dynamics of indices. As correlational evaluation, the higher the factor loading of an index in a principal component, the higher its correlation is with the other indices with high factor loadings in the same principal component (PennState, 2017).

4.1 The Co-Movements of Index Closing Prices Change During First Period

There are two statistically significant components for this period in Table 2. BIST100, CAC 40, IBEX 35 and NIFTY 50 have their highest factor loadings in the first principal component. As well, it is acceptable that 12 stock indices' closing prices (except RTS INDUSTRY and BOVESPA BRASIL) are closely correlated with each other. During the 2008 mortgage crisis, it is a known truth that the crisis had directly effects on stocks as bear in the USA and then affected other continentals'. But in this period as the first principal component, European indices with Hong Kong stock market have co-movement as closing prices. By supporting the study of Meric's (et. al) study in 2008, it is not convenient to use these seven indices' stocks in the same portfolio to provide substational diversification benefit during bear market. On the other hand, RTS INDUSTRY and BOVESPA BRASIL have not high factor loadings in the first principal.

By contrast with the first principal component, in the second principal of this bear period, RTS INDUSTRY and BOVESPA BRASIL have their highest factor loadings. It is showing that the closing prices of these two stocks are closely correlated. Therefore, it is not convenient to use these two stocks in the same portfolio. For rational index diversification, the investor should invest in indices with high factor loadings in different principal components.

On the other hand, FTSE 100, DOW JONES 30, KOREA KOSPI, Standart & Poors 500 and NASDAQ 100 have high factor loadings in both principal components. Therefore, these indices cannot provide successful portfolio divercification due to

the fact that they are correlated with the indices with high factor loadings in both principal components. To sum up, for successful index diversification, the investor should pick one index with a high factor loading from each of the principal components for this bear period. (For instance BIST 100 and BOVESPA BRASIL from each of the principal components.)

4.2 The Co-Movements of Index Closing Prices During Second Period

Compared with bear period during the mortgage crisis, during bull period, the change of index dynamics is indicated by principal component analysis. In Table 3, there are two statistically significant principal component in the bull markets. NASDAQ 100, DOW JONES 30, Standart & Poors 500, KOREA KOSPI, DAX, FTSE 100 and BIST 100 have their highest factor loadings in the first principal component. With NIFTY 50 and RTS INDUSTRY, it is acceptable that 9 stock indices' closing prices are closely correlated with each other for the first principal component during bull market. By supporting the study of Meric's (et. al) study in 2008, it is not convenient to use these nine indices' stocks in the same portfolio to provide substational diversification benefit during bull market. On the other hand, CAC 40, EURO STOXX, IBEX 35, HANG SENG and BOVESPA BRASIL have not high factor loadings in the first principal.

Contrast to the first principal component, in the second principal of this bull period, CAC 40, EURO STOXX, IBEX 35, HANG SENG and BOVESPA BRASIL have their highest factor loadings. It is indicated that the closing prices of these five stocks are closely correlated. Therefore, it is not convenient to use these five stocks in the same portfolio. For rational index diversification, the investor should invest in indices with high factor loadings in different principal components.

Additionally, NIFTY 50, RTS INDUSTRY and FTSE 100 have high factor loadings in both principal components. Therefore, these indices cannot provide successful portfolio divercification owing to the fact that they are correlated with the indices with high factor loadings in both principal components. To sum up, for successful index diversification, the investor should pick one index with a high factor loading from each of the principal components for this bull period. (For instance NASDAQ 100 and CAC 40 from each of the principal components.)

Table 2. The Co-Movements of Indices as Closing Prices: The Factor Loadings of the Principal Components in Bear Markets. (October 10, 2007 – February 2, 2009 First Period Bear Market)

Rotated Component Matrix[a]

	Component	
	1	2
BIST 100	,916	,380
CAC 40	,849	,523
IBEX 35	,842	,518
NIFTY 50	,841	,502
EURO STOXX	,837	,543
DAX	,827	,554
HANG SENG	,814	,566
FTSE 100	,777	,618
DOW JONES 30	,752	,650
KOREA KOSPI	,749	,639
Standart Poors 500	,739	,665
NASDAQ 100	,708	,663
RTS INDUSTRY	,423	,886
BOVESPA BRASIL	,497	,854

Table 3. The Co-Movements of Indices as Closing Prices: The Factor Loadings of the Principal Components in Bull Markets. (February 3, 2009 – December 28, 2012 Second Period Bull Market)

Rotated Component Matrix[a]

	Component	
	1	2
NASDAQ 100	,988	-,063
DOW JONES 30	,986	,045
Standart Poors 500	,982	,093
KOREA KOSPI	,907	,328
DAX	,897	,371
FTSE 100	,885	,429
BIST 100	,881	,376
NIFTY 50	,747	,575
RTS INDUSTRY	,661	,591
CAC 40	,198	,950
EURO STOXX	,278	,942
IBEX 35	-,396	,892
BOVESPA BRASIL	,402	,834
HANG SENG	,539	,804

4.3 The Co-Movements of Index Closing Prices During Third Period

Compared with bull period between February-2009 and end of 2012, during relatively-bull period which is between 2013 and end of 2016, the index dynamics is not changed utterly and the change is relatively; therefore, it could be seen in principal component analysis. In Table 4, there are two statistically significant principal component in the bull markets. NASDAQ 100, DOW JONES 30, DAX, NIFTY 50, EURO STOXX and CAC 40 have their highest factor loadings in the first principal component. With IBEX 35, it is acceptable that 7 stock indices' closing prices are closely correlated with each other for the first principal component during bull market. Interestingly, RTS INDUSTRY is entirely correlated with each other negatively. During this relatively bull period, this Russian stock index lost its value as more than %58. By supporting the study of Meric's (et. al) study in 2008, it is not convenient to use these seven indices' stocks in the same portfolio to provide substational diversification benefit during bull market. On the other hand, HANG SENG, FTSE 100, KOREA KOSPI, BOVESPA BRASIL, IBEX 35 and BIST 100 have not high factor loadings in the first principal.

Contrast to the first principal component, in the second principal of this relatively-bull period, HANG SENG, FTSE 100, KOREA KOSPI and BOVESPA BRASIL have their highest factor loadings. It is indicated that the closing prices of these four stocks are closely correlated. BIST 100 and IBEX 35 may also added into the same group. Therefore, it is not convenient to use these six stocks in the same portfolio. For rational index diversification, the investor should invest in indices with high factor loadings in different principal components.

Furthermore, IBEX 35 and CAC 40 have high factor loadings in both principal components. Therefore, these indices cannot provide successful portfolio diversification due to the fact that they are correlated with the indices with high factor loadings in both principal components. To sum up, for successful index diversification, the investor should pick one index with a high factor loading from each of the principal components as examples above for this relatively-bull period. (For example, NASDAQ 100 and HANG SENG from each of the principal components.)

Table 4. The Co-Movements of Indices as Closing Prices : The Factor Loadings of the Principal Components in Relatively-Bull Markets. (January 8, 2013 – December 29, 2016 Third Period Relatively Bull Market)

Rotated Component Matrix[a]

	Component	
	1	2
NASDAQ 100	,961	,036
Standart Poors 500	,955	,133
RTS INDUSTRY	-,933	,199
DAX	,926	,287
DOW JONES 30	,913	,180
NIFTY 50	,902	,198
EURO STOXX	,881	,327
CAC 40	,862	,337
HANG SENG	,171	,886
FTSE 100	,193	,808
KOREA KOSPI	,337	,790
BOVESPA BRASIL	-,190	,716
IBEX 35	,506	,522
BIST 100	,087	,462

5. Summary and Conclusion

Due to the fact that co-movements studies especially global stock market index prices co-movements is a popular research topic in finance literature, it is important to add bull&bear periods into these kind of researches in order to reveal the differences among periods. The closing prices of 14 stock indices are used in the principal component analysis in order to make them group as their similarities of their price movements. During bear period which is called the 2008 Mortgage Crisis, the indices in the same principal component are highly correlated and those indices have a low correlation in second principal component. Thus, it is claimed that in a bear market, investors may select one highest index from each of the two principal components in order to provide the successful portfolio diversification. Moreover, during the bull and relatively-bull periods, the same method may be used in order to utilize from successful portfolio diversification.

This study has a contribution to the portfolio diversification literature compared to other studies by covering both the Mortgage crisis and bull periods and also relatively bull periods which is ending at the end of 2016. Moreover, this study gives an updated analysis with regard to co-movements of various indices located in four continental. Therefore, it can be accepted that this study is geographically wider than other studies in literature during the analyzed same period.

This empirical study may be enriched by analyzing these periods with regard to not only indices but also specific sector breakdowns such as technology, material, production, finance and innovation. On the other hand, other methods such as discrete wavelet transform analysis, univariate analysis or bivariate analysis may be used to indicate the co-movements of indices and define the result differences among other analysis with the same data.

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