# Volatility Transmission between PALS, FOES, MINIONS and TITANS

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**Abstract:** *The main reason to conduct the study is to examine that either volatility is transmitted by friends, foes or stronger economies of the world. Daily stock returns from July 1997 to October 2013 from fourteen economies of the world were analyzed. EGARCH model is applied to investigate volatility spillover. Our findings suggests that volatility transmission occurs between countries having friendly terms but no evidence of volatility transmission is found between rivals.*
**Keywords:** *PALS, FOES, MINIONS, TITANS.*

## I. Introduction

Financial crisis pose a threat to the economy of any country. Recent financial crisis in the last decade for example the crisis in 2000-01 in turkey, early recessions from 2000-2003 (which affected European union in 2000 and 2001 and also affected US in 2002), 2001 argentine crisis, the dot com bubble crisis covering 1997-2000(which touch its climax in 10 march 2000 with NASDAQ peaking at 5408.60), the global economiccrunch from 2007-2008 and European sovereign obligation crisis that occurred in 2010. These crisis not only effect the country from which originated but also it transmitted to the Asian economies like Indonesia, Philippines, Taiwan, Korea and Thailand.

It is argued that financial crisis have a great impact on the economies that are connected to the economy in which the crises originates. These crises lead to volatility transmission between countries which means that crisis in one economy leads to crisis on another, usually these shocks are transferred between countries whose markets are integrated with each other. According to (Bekaert, 1997) the markets will be well integrated if the policies between the countries are liberal. The liberalization in the economy will increase the correlation between the markets which in turn will result in strong volatility spillover between the markets. Later (Choudhry, 2004)found that volatility transmission do not depend on the friendly relation or space between countries. (Abbas, Khan, & Shah, 2013)examined the Asian markets and found that volatility spillover is also present between the nations that are not on welcoming terms and likewise found that mostly spillover is transmitted from stronger to weaker markets but there is also evidence of transmission from weaker to stronger markets. They further concluded that volatility spillover will be transmitted between countries who are not on friendly terms if their trade and commerce links are open.

This study will be beneficial for the investors because it provides information to the investors that how much spillover will be transmitted from one country to another which gives them diversification opportunities to invest their money from one country to another. This study also provides evidence that there is no spillover from India to Pakistan and Pakistan to India which means that volatility spillover do not depend on geographical connection between the countries.

This study will be significant mainly for the investors because it provides information that either the volatility is transmitted from one country to another. This will help the investors to diversify their risk.

The objective of the study is to investigate that either volatility is transmitted from friends, foes or big economies. Our study is different than previous research because our sample contains countries which have are on friendly terms as well as unfriendly terms. The research also takes into account the big titans like UK, US, Japan etc. of the world

## II. Literature Review:

Due to integration in financial markets a crises in one country may spill over to the other country. Some researchers (Bekaert, 1997)attribute this change to the liberalization policies adopted by many countries. Other researchers (G & Tse, 1997) consider that advance computer technology is responsible for this integration in the financial markets. Integration in markets is not limited to a specific area, the proof is found around the globe; many researchers like (Ng, 2000)examined the degree and the unevenflora of volatility spillover to six pacific-basin equity markets from Japan and US and found that volatility in pacific-basin is swayed by the international shocks from other national markets and constructed a model in which the assumption was that shocks have three foundations and analyzed that how much return volatility is caused by world factor and how much regional factor is contributing towards this volatility in the pacific-basin. It standssignificant for figuring the importance of the two biggest economies of the world on minor markets. The pacific-basin has liberalized

their policies to increase the investment between countries. According to (Bekaert, 1997)there would be more correlation between local and world markets if the policies are liberalized. When the correlation is increased due to liberalization than there are greater chances of solid volatility spillover. He further investigated that liberalization events increase or decrease the size of volatility spillover or not. The outcomes of the study disclose that provincial and world factors together are vital for market instability in the region while the world market effect tends to be greater. Main liberalization events like changes in foreign investment restriction can influence the comparative status of provincial and world market aspects and last but not least that local and world elements which are captured by pacific-basin are quite small.

(Choudhry, 2004)examined the trends of volatility spillover and mean returns of the markets friendly political and rival countries. The three pairs of countries are used which were Pakistan and India, Greece and turkey and Israel and Jordan. He examined the spillover between these country's markets and also of US since it likes opendealings with these republics. (Choudhry, 2004) applied GARCH and found that mean yields and volatility transmission do not depend on the open dealings and space amongstates.

(Abbas, Khan, & Shah, 2013). studied the Asian markets and found that there is plenty evidence on the existence of volatility diffusionamong the republics that are on not friendly political terms. It indicates the existence of volatility diffusion to Pakistanfrom Indiaand the transmission between the two countries is two way. If we examine this study in detail we will see that volatility spillover is mostly transmitted from larger to smaller markets but some evidence indicated that transmission from smaller to larger markets is also present. The outcomes of the study show that volatility spillover will be transmitted between the countries which are not on friendly terms if their trades and commerce links are open. Furthermore in this study we see that Pakistan and china are very much connected with each other geographically and have friendly relationship but volatility spillover between these countries is null. After seeing these results (Abbas, Khan, & Shah, 2013)analyzed that Pakistan's economic factors are playing an important towards volatility transmission rather than political or other factors.

(Johansson & Ljungwall, 2008) explored the three greater Chinese markets and initially founded that all three markets are non-static and they are not co-integrated related which gives a clear meaning that the three return series have no long term relationship. He used a multivariate volatility model because Hong Kong and Taiwanese markets has asymmetric tendencies in the volatility.The results of the model show that china and Hong Kong market has been effected in the mean by the spillover of Taiwanese market. Results also show that spillover from Hong Kong is also transmitted to Taiwanese market which tells that both these markets are very well integrated. However Chinese market is swayed by Taiwanese market but it don't sway the further two markets. By using the model he documented the spillover effect transmitted from Taiwanese marketplace to the market of China which was new to the literature and concluded that there are no uneven features in the instability of Chinese market because market has very small sized firms and the trade investors are quiet dominant moves in the market.

(PIESSE & HEARN, 2005)examined the sub Saharan African markets and provided some evidence that emergentparity markets in the sub Saharan region are integrated and their part in the growth of markets, growth of the economy and growth of the state. They used the ten nationwideparity markets that are collectively covering the sub Saharan state and applied EGARCH model to analyze the inside market instability, irregularity of volatility and the inter-market spread of volatility. Finally he clinched that the markets that are cohesive and are moving ahead well as compared to the markets that are segmented and secluded.

(Yeh & Lee, 2000)examined the greater Chinese markets and found that the return volatility of the Chinese markets respond more to decent news than to depraved news in GJR GARCH. The outcomes in this study also display that HongKong market's unexpected return has no impact on Shanghai and Shenzhen compound indices that are dominated by A share but unexpected shocks from HongKong market do have concurrent and cross-dated effect on B market share of Taiwan Shanghai and Shenzhen markets. During the Taiwan crisis stock market of Taiwan is found to be adversely correlated with the B share of Shenzhen market so this demonstrates that political incidents have impact on Chinese markets.

(Wang & Firth, 2003)investigated the Chinese markets and found that instant returns on China stock catalogs can be assessed by the utilizing the materialfrom one or more three main worldwide stock markets using the morning yields. The simultaneous yieldtransmissions are in one way direction and there is robust evidence that emergent Chinese markets in before the crisis period are effected by the return spillover of advanced and developed markets. Nevertheless bi directional return spillover was found after the crisis. The study also found that there stand no one-retro delayed spillover effects from the three developed markets to Chinese markets. This shows that Chinese markets change according to news from UK and US markets in well-organized way.To sum up the study concludes that the main Chinese markets which are Shanghai and Shenzhen are not exaggerated by overdue and simultaneous bad news. While the findings of the study suggest that Chinese markets are moderately cohesive with the global stock markets.

(Wang & Wang, 2010)examined the link among the emerging Chinese stock marketplace and the settled stock marketplaces of US plus japan and concluded three major results. Frist he concluded that between

Chinese stock market and US and japan stock market volatility spillover is much stronger than price spillover and there is medium of correlation of volatility spillover between these markets exist but the medium is too frail to be noticeable.Next the speculation that the lager established stock markets control the emerging markets is probed in this study. The previous studies show that the emergent markets are smaller than established markets and are dominated by them. But the present results in the study show that there is very limited equal volatility transmission between Chinese stock marketplaces and the settled stock marketplaces of Japan and US. While it is the US market who is more responsive to shocks when inter-marketinfluence is troubled. Thirdly concluded that impact of developed market on emerging markets depends upon the openness of developed economy and as the degree of openness decreases the impact also decreases and also decreases if the geographical distance is increased. So final conclusion of the study is that when the emerging markets take the restrictions off then they become integrated with the developing markets and then can be influenced by the developed markets.

(Qayyum & Kemal, 2006)investigated the Pakistani market and found that on a daily base data from Karachi stock exchange volatility transmission is present between Pakistan stock market and foreign exchange.

(Dania & Spillan, 2012)examined MENA (Middle EastNorthAfrican) and main major markets of the world to determine that whether volatility spillover is transmitted to MENA by major world markets or not. (Dania & Spillan, 2012)institute that there is evidence that a constructive volatility spillover is transmitted from France to Kuwait, morocco and Tunisia. The positive spillover relation means that if volatility increase in France then it also increases in these nations. There is also a proof of negative associationamong Lebanon and France which shows that if volatility in France decrease then volatility in Lebanon decreases. for instance in Germany has positive relationship withOman morocco Kuwait and Tunisia and UK has a positive spillover relation with Kuwait morocco and Tunisia and finally US has a positive relation with Kuwait and Tunisia which show that these MENA region marketplaces are very well united with the major marketplaces of the world. Generally here is diverse indication of global spillover from major markets to MENA region marketplaces. (Dania & Spillan, 2012) further conclude that liberalization in financial markets do not bring an instant integration with the worldwide market because integration is a long run process.

(Shamiri & Isa, 2010)investigated the vigorous contact and varying flora of the yield and instabilitytransmission from Japan and US to the Pacific markets of Asia. The first major finding of the study is that merelyAsian-pacific markets have impact from the US market and noimpact from japan to the Asia-pacific markets. Another finding of the study is that Singapore, Korea and Hong Kong standfurther inclined to the variations in the US economy such as the US financiersgrasp 18.77%, 13.97% and 5.39% of Asian-pacific entire market capitalization.In totingHong Kong and Singapore grasp 2.91 and 38.89 percent individually of US possessions to the sum of their marketplace capitalization. These huge ratios will upswing their perildisclosure to the US economic markets. Final finding of the study is that Asian-pacific markets were influenced more by the Japanese markets for the eraaforecrunch. But for the recent period it is not correct, such as capital driftsto Asia-pacific marketplaces from USA have made USA the keycause of global volatility to the region.

(Bhargava , Malhotra, Russell , & Singh, 2011) examined US and Indian stock markets and institute that no indication of volatility transmission is found from India to US market.

(Singh, Kumar, & Pandey, 2010) examined the volatility and price spillover throughAsian, Europe stock markets and North American stock markets anddesignated that there is betterlocalimpactamongstEuropean stock and Asian stock markets.

(Chi , Li, & Young, 2006) utilized international capital pricing model to inspect the range of economicassimilation that exist in East Asian marketplaces.to check the inter linkages chi used three market portfolios which included one-sidedregularparitycatalog of all states. He used Index of Japanese market and the US market index and concluded that through 1991-2005 the degree of economiccompetence and the consolidation of valued countries is raised and has boosteddeeply.

(Khan & Sajid, 2007)analyzed the strand of interest to inspect the monetary market inter links of South Asian thrifts. They analyzed integration face to face United States by gainingperiodicfigures of interest rates from 1990 to 2006 and found that there is little level of assimilation in the state. (Liu & Pan, 1997)inspected the spillovers of mean and volatility to the four stock markets of Asia from Japanese and US stock marketplaces and concluded that United States is extrapersuasive than Japan in conveyingyields and volatilities to the four stock markets of Asia which shows that these four Asian markets are more united with US market.

(Wongsman, 2006) examined the information transmission from japan and US to Thai and Korean equity markets and found that there is great and momentous connotationamongstestablished markets and the emergent markets at little time horizon.

(Johnson & Soenen, 2002)inspected the integration of Japan with 12 markets of Asia and institute that Japanese market is very well integrated with developed markets like Australia, china,HongKong and emergent markets like Malaysia, Singapore and new Zealand. (Lee, 2009)took six Asian countries and examined the volatility spillover effects by using the bivariate GARCH model and establish that there are statistically momentous spillovers propertiescrosswise the stock markets of the countries mentioned above. (Jang & Sul, 2002)found that during Asian crisis co dynamismamongst Asian marketplaces is amplified. (Kimb , Yoonb, & Viney,

2001)Deliberate the volatility spreadamongstAsian markets throughout the monetarycatastropheretro from 1997-1998 and found that there is mutual transmissionamongstKorea and Hong Kong.

(Syriopoulos, 2007)scrutinized the brief and long term connectionsamongstemergent markets and the established markets of Europe and concluded that developing marketplaces are well mutually united with their established counter parts.

(Bala & Premaratne, 2004)studied the spillover to the Singapore marketfrom Hong Kong Japanese US and UK markets and elevategreat degree of volatility mutual variation among the market of Singapore and Hong Kong, Japan, US and United kingdom market.

(Dao & Wolters, 2008)observed the volatility interrelationship of major stock indices like Dow jones and Company (^DJI), Nikkei stock average, Hang Seng index (^HSI) and Straits time index (^STI). By using the implicit volatility model they institute that volatilities of the major indices mentioned aboveprogressed together.

The cause of integration is not limited to geographical attachments but some researchers also noticed that trade between different countries can also influence the integration between different markets.

This study is different from previous studies because it investigates volatility transmission between different countries around the sphere. The tasterutilized in our revision is representative of the population as it contains foes like India and Pakistan and friends like china and Pakistan and it also contains main economies like Japan, US, UK and Australia. The study will be useful to the researchers and academicians in understanding volatility transmission between different countries.

# III.    Methodology

**Sample**

To investigate the volatility transmission between different economies we select a sample of 16 countries from different regions of the world. The sample is diverse as it contains foes like India and Pakistan and friends like China and Pakistan the main economies like US, Japan, Australia etc are also included in our sample. Some other countries like Korea, Malaysia, and Sri Lanka are also taken in our sample and they don't lie in the previous three categories.

To examine that either volatility flows from one economy to another main stock exchanges of countries are taken with daily frequency. The prices are then converted into returns by using the formula ( $\dfrac{p_n}{p_{n-1}} - 1$

)before applying ARCH family models we checked all the series for unit root test. T statistic of each country are reported in table one. To check the distributional features of the stock returns descriptive statistics are reported in table 1 which include mean, median, extreme standard deviation, least standard deviation, Skewness , kurtosis, and Jarque-Bera statistic. We found that Colombo stock exchange is offering greatest daily mean return of .08%. Colombo stock exchange also offers the maximum value of daily stock return i.e. 26.58%. Returns of some stocks like Australia, Canada, Germany, japan, Korea, Pakistan and USA is found to be negatively skewed. It means that distribution has long left tail. From the negative skewness we can conclude that probability of loss is greater in the above said countries. Also the distribution for all countries is found leptokurtic and have fat tails (which means a bell curve) when compared against standard distribution. That's why the jarque-bera statistic lead us to the conclusion that the distribution is not normal in table-1.

**Descriptive Statistics**

**Table 1**

|  | CANADA | CHINA | FRANCE | GERMANY | HONGKONG | INDIA | JAPAN | KOREA |
|---|---|---|---|---|---|---|---|---|
| Mean | 0.000347 | 0.000399 | 0.000302 | 0.000611 | 0.000354 | 0.000765 | 4.69E-05 | 0.000621 |
| Median | 0.000682 | 6.93E-05 | 0.000345 | 0.001403 | 0.000297 | 0.001065 | 0.000184 | 0.000939 |
| Maximum | 0.091274 | 0.097747 | 0.178395 | 0.107023 | 0.184810 | 0.174857 | 0.130659 | 0.148704 |
| Minimum | -0.129542 | -0.132102 | -0.095693 | -0.118615 | -0.147617 | -0.174800 | -0.114064 | -0.172306 |
| Std. Dev. | 0.013935 | 0.018960 | 0.018349 | 0.015532 | 0.020087 | 0.020258 | 0.018232 | 0.023711 |
| Skewness | -0.446015 | 0.043302 | 0.527611 | -0.159969 | 0.329073 | 0.120357 | -0.088853 | -0.123718 |
| Kurtosis | 11.82410 | 7.425344 | 9.991740 | 8.598500 | 12.05449 | 11.97191 | 7.813151 | 9.280586 |
|  |  |  |  |  |  |  |  |  |
| Jarque-Bera | 9301.603 | 2316.656 | 5912.255 | 3718.438 | 9745.810 | 9525.407 | 2743.163 | 4671.701 |
| Probability | 0.000000 | 0.000000 | 0.000000 | 0.000000 | 0.000000 | 0.000000 | 0.000000 | 0.000000 |
|  |  |  |  |  |  |  |  |  |
| Sum | 0.984018 | 1.131389 | 0.856328 | 1.734564 | 1.003619 | 2.170844 | 0.133038 | 1.763375 |
| Sum Sq. Dev. | 0.550919 | 1.019811 | 0.955206 | 0.684366 | 1.144708 | 1.164295 | 0.943021 | 1.595004 |
|  |  |  |  |  |  |  |  |  |
| Observations | 2838 | 2838 | 2838 | 2838 | 2838 | 2838 | 2838 | 2838 |

|  | MALAYSIA | PAKISTAN | SINGAPORE | SRILANKA | TAIWAN | UK | USA | AUSTRALIA |
|---|---|---|---|---|---|---|---|---|
| Mean | 0.000337 | 0.001119 | 0.000325 | 0.000823 | 0.000154 | 0.000229 | 0.000350 | 0.000308 |
| Median | 0.000246 | 0.001429 | 0.000614 | 0.000491 | 0.000195 | 0.000555 | 0.000707 | 0.000727 |
| Maximum | 0.219700 | 0.136124 | 0.239542 | 0.265880 | 0.174413 | 0.132431 | 0.093477 | 0.065474 |
| Minimum | -0.175076 | -0.163504 | -0.150245 | -0.129820 | -0.119951 | -0.072203 | -0.103267 | -0.089894 |

| Std. Dev. | 0.017764 | 0.019626 | 0.017498 | 0.015635 | 0.018856 | 0.015010 | 0.014755 | 0.011609 |
|---|---|---|---|---|---|---|---|---|
| Skewness | 1.702100 | -0.406262 | 0.904074 | 1.592255 | 0.118616 | 0.316206 | -0.158685 | -0.450794 |
| Kurtosis | 41.15397 | 9.965247 | 23.02185 | 43.19599 | 9.887353 | 8.962748 | 8.905070 | 8.333803 |
| | | | | | | | | |
| Jarque-Bera | 173509.8 | 5814.927 | 47789.99 | 192257.8 | 5615.918 | 4251.597 | 4135.270 | 3460.268 |
| Probability | 0.000000 | 0.000000 | 0.000000 | 0.000000 | 0.000000 | 0.000000 | 0.000000 | 0.000000 |
| | | | | | | | | |
| Sum | 0.955230 | 3.176554 | 0.923326 | 2.336927 | 0.438197 | 0.650415 | 0.993536 | 0.873083 |
| Sum Sq. Dev. | 0.895271 | 1.092806 | 0.868629 | 0.693515 | 1.008641 | 0.639200 | 0.617609 | 0.382310 |
| | | | | | | | | |
| Observations | 2838 | 2838 | 2838 | 2838 | 2838 | 2838 | 2838 | 2838 |

We found an ARCH effect in our data by applying hetroskedacity ARCH. The F statistic and the respective probabilities are stated in table-2. From the results of the table we can conclude that we should apply ARCH family models

## ARCH

**Table 2**

| Countries | F statistic | Probability |
|---|---|---|
| Japan | 25.71960 | 0.0000 |
| China | 13.28056 | 0.0003 |
| Australia | 111.3611 | 0.0000 |
| France | 14.87160 | 0.0001 |
| Pakistan | 75.81992 | 0.0000 |
| India | 50.62298 | 0.0000 |
| Sri Lanka | 8.854783 | 0.0029 |
| Germany | 105.6132 | 0.0000 |
| Korea | 93.10708 | 0.0000 |
| Malaysia | 147.2671 | 0.0000 |
| Hong Kong | 30.65058 | 0.0000 |
| USA | 187.6568 | 0.0000 |
| UK | 56.69133 | 0.0000 |
| Singapore | 22.98009 | 0.0000 |
| Taiwan | 8.374130 | 0.0038 |
| Canada | 129.7133 | 0.0000 |

## Criterion Tables

**Table 3**

| Models | Schwarz criterion | Hannan-Quinn criter | Akaike info criterion |
|---|---|---|---|
| ARCH Model | -5.249467 | -5.276277 | -5.291404 |
| GARCH Model | -5.132757 | -5.155546 | -5.168404 |
| EGARCH | -5.287858 | -5.311986 | -5.325601 |
| TGARCH | -5.238043 | -5.262171 | -5.275786 |

From akaike information criteria and schwarts criteria we come to the conclusion to apply EGARCH model to our data.

$$\text{Log } \sigma^2_{t} = \text{ɯ} + \sum_{k=1}^{q} \beta_k \, g(Z_{t-k}) + \sum_{k=1}^{p} \alpha_k \log \sigma^2_{t-k}$$

From EGARCH variance equation we found that current day's variance of Karachi stock exchange (KSE) is not only effected by volatility of previous day but also effected by other variance regresers like Hong Kong daily returns, china daily returns, France daily returns, Germany daily returns, japan daily returns, Taiwan daily returns and USA daily returns. But Indian stock returns, Korea stock returns, Malaysia stock return, Singapore stock return and UK stock return do not contribute to volatility of KSE.

## EGARCH Model

**Table 4**

| Variable | Coefficient | Std. Error | z-Statistic | Prob |
|---|---|---|---|---|
| ɯ | -0.783793 | 0.050327 | -15.57398 | 0.0000 |
| C3 | 0.295025 | 0.018491 | 15.95513 | 0.0000 |
| C4 | -0.062518 | 0.009962 | -6.275440 | 0.0000 |
| C5 | 0.929785 | 0.005251 | 177.0572 | 0.0000 |

| China | 1.734966 | | | |
|---|---|---|---|---|
| | | 0.559024 | 3.103565 | 0.0019 |
| France | -3.778827 | 1.187926 | -3.181029 | 0.0015 |
| Germany | -6.222666 | 1.157656 | -5.375228 | 0.0000 |
| Hong Kong | -3.597153 | 0.855494 | -4.204765 | 0.0000 |
| India | 0.187478 | 0.497972 | 0.376484 | 0.7066 |
| Japan | 4.222037 | 0.860553 | 4.906191 | 0.0000 |
| Korea | 0.714733 | 0.590693 | 1.209992 | 0.2263 |
| Malaysia | -0.043077 | 0.721272 | -0.059724 | 0.9524 |
| Singapore | -1.298824 | 0.987913 | -1.314715 | 0.1886 |
| Sri Lanka | -0.952680 | 0.512327 | -1.859515 | 0.0630 |
| Taiwan | 1.136764 | 0.543889 | 2.090067 | 0.0366 |
| UK | -1.778304 | 1.972163 | -0.901702 | 0.3672 |
| USA | 13.46103 | 1.371303 | 9.816232 | 0.0000 |

## IV.    Conclusion

From our results we conclude that volatility in Pakistani stock market is not only effected by the volatility in main economies of the world like USA, France, Germany, and japan but is also effected by volatility in mainland china and its affiliated territories  like Hong Kong and Taiwan.  The study support the idea that mostly of the volatility transmission is from stronger economies as in the Asia-pacific region volatility is transferred from japan and china but volatility spillover is not found from countries like Malaysia, Korea and Singapore. The research also concludes that countries with friendly relationship may be a source of volatility transmission whereas countries having unfriendly terms may not be a source of added volatility.

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