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Does Geopolitical Risk Drive Equity Price Returns of BRIC Economies? Evidence from Quantile on Quantile Estimations

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Abstract: *This research aims to study the effects of geopolitical shocks on the equity market returns of BRIC economies. Quantile on quantile regression (QQR), a non-parametric technique was used to capture the relationship between the said variables. The results confirmed a heterogeneous response of BRIC equity returns to their own country geopolitical risk. Brazilian and Russian funds were found to be more responsive to the geopolitical shocks, whereas, Indian and Chinese funds have shown resilience to the geopolitical uncertainties. The policy recommendations based on the findings are also discussed in the study.*

Keywords: Geopolitical Risk, stock price returns, BRIC economies, quantile on quantile estimations.

Introduction

The increasing economic and political upheaval often pose a risk on the economy generally regarded as 'Geopolitical risk' (GPR). Geopolitical risk is often termed as, the risk originating from a wide range of events that disturb the peaceful course of international relations. These events may include terror assaults, military attacks, political tensions within or across the borders, or, even a climatic change (Caldara & Iacoviello, 2018). The global investors' survey (2018) by PwC reported geopolitical risk to be one of the key determinants for making investment decisions by the market participants, entrepreneurs and the central banks officials. It has also been regarded as a major threat to economic outlook. Carney (2016) included geopolitical risk in the 'uncertainty trinity' along with the economic and policy uncertainty and proposed that geopolitical uncertainty could have severe economic impacts. Therefore, it is important to study the dynamics of geopolitical risk.

With the change in the nature of policy decision making and their implementation processes, it is being expected by the policy makers that geopolitical risk can create greater economic uncertainty. Previously, the world has witnessed some major geopolitical events like the 9/11 attacks followed by the global war against terrorism, UK's exit from the European union, global financial crisis of 2008-2009 etc. which have persuasively changed the scenario all across the globe. These events and the subsequent perceived risk arising from them have ignited the interest of the researchers in their impact on different areas of

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economy. In the past, the researches attempted to check the impact of terrorism, wars, military assaults on different macroeconomic variables in general (Bloom, 2009; Fernández-Villaverde, Guerrón-Quintana, Kuester, & Rubio-Ramírez, 2015). The discussion on impact of an 'uncertainty' be it economic or geopolitical on investments in particular and the economy in general is crucial. Various theoretical approaches have been established in the past which recognized and discussed the impact of uncertainty on investments. Two of such approaches were presented by Bernanke (1983); Dixit and Pindyck (1994) and proposed that 'uncertainty' is inevitable. However, an investor can reduce its cost by evaluating the alternatives which can yield him greater profit. Moreover, after the financial crisis of 2008-2009, a huge body of literature talked about the impact of different uncertainties on the capital markets (Gupta, Hammoudeh, Modise, & Nguyen, 2014; Kang & Ratti, 2013, 2015; Mensi, Hammoudeh, Yoon, & Nguyen, 2016) and many more. The findings of these studies suggests that uncertainties have a negative impact on the equity returns and they also increase the overall volatility of the market.

The impact of geopolitical risk for the equity market can be understood thorough various channels and it can impact the asset prices in many ways. First and foremost, when an uncertainty strikes an economy, it delays the decision making process of the firms and investors. Secondly, it pushes up the production and financing costs by negatively affecting both demand and supply channels It also intensifies disinvestments and economic contraction. Thirdly, it increases the risk associated with investment in financial market.

Owing to the facts stated above, the current study tries to analyze the impact of movement in the geopolitical risk on the equity returns of the BRIC economies. The reason of choosing these particular economies is quite obvious. These economies have shown a fast paced growth and their integration with the developed world has also increased in terms of investment and trade in recent years (Balcilar, Bonato, Demirer, & Gupta, 2018). BRIC Economies comprises of almost quarter of the total land of the world, half of the total population of the world, and around one-sixth portion of global production. It is being anticipated that these economies will have a share of about 40% in the stock market capitalization by 2030, while China surpassing USA in equity market (Mensi, Hammoudeh, Reboredo, & Nguyen, 2014; Mensi et al., 2016). Therefore, looking at the dynamics of BRIC economies is quite imperative.

In earlier studies, researchers have tried to assess the impact of different geopolitical events individually on the financial markets. For instance, the impact of terror assaults on the financial markets has been analyzed by various researchers (Chen & Siems, 2004; Arif, Iqbal, Ali, & Sohail, 2017; Drakos, 2010) and they found a significant negative correlation between the equity returns of world's major markets and terror assaults. Literature also contains some examples where the impact of a number of geopolitical events have been assessed on the financial markets by constructing a disaster risk index. The index was computed by counting the number of political tensions in the studied countries over a period of time, (Gourio, 2008; Bernanke, 1983; Blomberg, Hess, & Orphanides, 2004; Tavares, 2004; Barro, 2006). However, our study is different from the mentioned studies in following ways. Firstly, it uses a recently computed GPR index by Caldara and Iacoviello (2018). It is a monthly index which is constructed by counting the frequency of words relating to geopolitical uncertainty in world's leading newspapers' articles. GPR index

is a much broader indicator than the formerly used disaster indices as it covers a number of variables that can cause geopolitical tensions including terrorism, military attacks, war risks etc. Moreover, in the past literature, the impact of disasters or terror assaults on the performance of financial markets is captured through conventional mean based regression approach. This approach may lead to biased estimates because of the heavy tails and non-normal distribution of stock market returns. Hence, using the conventional parametric estimations to capture movements in the stock returns may give misleading estimates.

The past literature contains a few attempts of using non parametric estimations to check the relationship between these two variables. One of them is the study conducted by Balcilar et al. (2018) which used non parametric causality in quantile approach to check the causal relationship between geopolitical risk and stock prices of the BRIC economies. It is reported that BRICS stock markets behave heterogeneously to the geopo-litical shocks where Russia was found to be the highest bearer of risk exposure with significant causality observed from GPR index to market returns. While their study is important in finance literature as it talks about the movement in the stock returns due to any geopolitical uncertainty, one major drawback of using causality in quantile approach that it does not indicate the extent and sign of the relationship for the variables in question. Hence, we aim to fill this gap by analyzing the direction and persistence of relationship between stock price returns and geopolitical risk of BRIC economies using a novel non parametric technique i.e., Quantile on Quantile (QQ) estimations developed by Sim and Zhou (2015).

The decision of relying on QQ estimations is taken due to its several advantages over the conventional mean based regression models. Firstly, it is a non-linear model and allows the estimates of the variables to vary across quantiles, and hence it can capture various trends of financial markets. Furthermore, since capital markets have skewed tails, hence using a quantile model is more suitable to estimate various trends of the market. It also helps in accounting for the significant information at the tails of distribution which cannot be provided by the conditional mean based regression models.

The rest of the paper is organized as follows, the next part contains a brief discussion on the data and methodology employed to go about the problem. Part 3 contains discussion on the empirical results and estimates, Part 4 concludes the study using suitable policy recommendations.

Data and Methodology

The study uses the news based geopolitical risk index constructed by Caldara and Iacoviello (2018). It is a broad measure of global uncertainty and includes a number of uncertainty factors such as terror attacks, military assaults, war risks etc. It allows for capturing various types of geopolitical tensions in a continuity and gives a more realistic picture of the changing geopolitical situations in the world. The index is constructed by counting the number of terms related to geopolitical risk in world's 11 leading newspapers. The search looks for eight phrases including geopolitical concern(s), war risk(s) geopolitical risk(s), military tension(s), and terrorist attack(s). The index is then normal-

ized to a value of 100 for the decade of 2000-2009. The data on GPR measure is available at policy uncertainty website [1]. For this study, we have used monthly data of geopolitical risk index for the period ranging from January 1985 to December 2017.

The monthly data for the equity prices of BRIC economies for the same period was obtained from yahoo finance [2]. The stock price indices used for the selected economies were IBOVESPA for Brazil, MICEX for Russia, BSE SENSEX for India and, SSE composite for China.

The Quantile on Quantile Regression approach (QQR) developed by Sim and Zhou (2015) is the generalized specification of standard quantile regression model where one can assess the effects of quantiles of one variable on the conditional quantiles of the other variable. The QQ method is a combination of a quantile regression where the impact of an exogenous variable on the quantiles of the dependent variable is checked and local linear regression, which is used to assess the local effect of a specific quantile of the exogenous variables on the dependent variable. For constituting the framework of the following study, the QQR methodology has been employed to examine and assess the impact of quantiles of the geopolitical risk on the quantiles of the stock market returns of the emerging economies. The following non-parametric quantile regression is used as the starting point:

$$ER_t = \beta^{\theta}(GRP_t) + u_t^{\theta} \tag{1}$$

Here, the ER_t denotes the stock price return of a given emerging economy in a specific time period t, GPR_t shows the weighted index of geopolitical risk in the BRIC economies in a given time period t, θ is the θth quantile of the of the conditional distribution of the stock price return in the emerging market economies and u_t^{θ} is the quantile error term with conditional θth quantile equal to zero. β^{θ} is an unknown parameter as we do not have prior information about the relationship between stock price returns and geopolitical uncertainty of the emerging market economies.

In the following study, the quantile regression models the impact of geopolitical risk of BRIC countries on their equity market returns while allowing the effect of geopolitical risk to vary across different quantiles of equity markets. The benefit of using this approach is its flexibility as no hypothesis has been developed related to the functional form of the relationship between GPR and equity price returns of the emerging economies. However, this approach has a disadvantage as it does not have the ability to assess the dependence structure in its entirety. Hence, the quantile regression does not account for the possibility that the nature of geopolitical shocks may also affect the manner in which the geopolitical risk and equity price returns are linked together. For instance, the impact of greater geopolitical shocks can have a greater impact on the equity price returns than the smaller shocks. Moreover, it is quite probable that stock price returns react asymmetrically to positive and negative geopolitical changes.

Therefore, to assess the impact on the θth quantile of ER of the emerging economies and τth quantile of GPR in BRIC countries, expressed as GPR^{τ}, the equation-1 is analyzed

[1] http://www.policyuncertainty.com/
[2] https://finance.yahoo.com/world-indices

in the neighborhood of GPR^{τ}, using local linear regression. Since, β^{θ} is an unknown parameter, the equation-1 can be approximated by a first order Taylor expansion around a quantile GPR^{τ}, so equation (1) is transformed as following:

$$\beta^{\theta}(GPR_t) \approx \beta^{\theta}(GPR^{\tau}) + \beta^{\theta\prime}(GPR^{\tau})(GPR_t - GPR^{\tau}) \tag{2}$$

Here, $\beta^{\theta\prime}$ is the partial derivative of β^{θ} (GPR_t) with respect to GPR and can also be said as marginal response. It is interpreted as the slope coefficient of the standard linear regression model. The main advantage of equation-2 is that the parameters $\beta^{\theta\prime}$ (GPR^{τ}) and β^{θ} (GPR^{τ}) are function of a both θ and τ , as β^{θ} (GPR^{τ}) and $\beta^{\theta\prime}(GPR^{\tau})$ are functions of θ and GPR^{τ} is a function of τ. Therefore, β^{θ} (GPR^{τ}) and $\beta^{\theta\prime}(GPR^{\tau})$ can be renamed as β_{θ} (θ, τ) and $\beta_1(\theta, \tau)$ respectively. So, equation-2 can be transformed as following:

$$\beta^{\theta}(GPR_t) \approx \beta_0(\theta, \tau) + \beta_1(\theta, \tau)(GPR_t - GPR^{\tau}) \tag{3}$$

After substituting equation-3 in equation-1, equation-1 becomes as following:

$$ER_t = \underbrace{\beta_0(\theta, \tau) + \beta_1(\theta, \tau)(GPR_t - GPR^{\tau})}_{(*)} + u_t^{\theta} \tag{4}$$

The (*) part of equation-4 is basically the 4 θth conditional quantile of ER of the emerging economies and shows the relation between the θth quantiles of ER of emerging markets and τth quantile of the GPR of these economies as the parameters β_0 and β_1 are dual function of θ and τ and these parameters may vary across different θth quantiles of ER and τth quantile of the GPR. Furthermore, the QQR approach assumes a linear relationship between the quantiles of variables in question in no point of time. Hence, equation-4 assesses the overall dependence structure between the equity returns of BRIC and their GPR using the dependence between their quantile distributions.

To empirically estimate equation-4, GPR_t and GPR^{τ} have to be replaced with their estimated counterparts i.e., $\widehat{GPR_t}$ and $\widehat{GPR^{\tau}}$, respectively. To obtain the local linear regression estimates of the parameters b_0 and b_1, which is the empirical estimates are of β_0 and β_1, following minimization function has to be solved:

$$min_{b_0 b_1} \sum_{i=1}^{n} \rho_{\theta} \left[ER_t - b_0 - b_1(\widehat{GPR_t} - \widehat{GPR^{\tau}}) \right] XK(\tfrac{F_n(\widehat{GPR_t} - \tau}{h}) \tag{5}$$

Here, $\rho_{\theta}(u)$ is the quantile loss function and can be defined as, $\rho_{\theta}(u) = u(\theta - I(u < \theta))$, where I is the usual indicator function, K (.) shows the kernel function and h is the bandwidth parameter of the kernel. The following study employs Gaussian kernel. It is widely used kernel function in financial and economic literature due its efficiency and simplicity. It is used to weight the data points in the neighborhood of GPR^{τ}. The Gaussian kernel has symmetrical distribution around zero and assigns low weights to the farther away observations. For the given study, we assume these weights to be inversely related to the distance between the empirical distribution function of $\widehat{GPR_t}$ and can be represented by, $F_n(\widehat{GPR_t}) = \frac{1}{n} \sum_k^n I(\widehat{GPR_k} < \widehat{GPR_t})$ and the value of the distribution function corresponding to the quantile GPR^{τ} is shown by τ.

Choosing the bandwidth is a critical task while using non-parametric estimation techniques. It determines the size of the neighborhood surrounding a specific data point and therefore controls the smoothness of resulting estimates. While a larger bandwidth corresponds to the greater probability of bias in the estimates, a smaller bandwidth may result in a greater variance. Therefore the bandwidth should be selected as such that a balance between bias and variance may be maintained. Following Sim and Zhou (2015), a bandwidth parameter h=0.05 is used in the study.

Empirical Estimations

Descriptive Statistics

Table 1 given below shows the descriptive statistics of geopolitical risk index and equity market returns of BRIC economies.

Table 1
Descriptive Statistics

PANEL A: Equity Market Returns				
	Brazil	**Russia**	**India**	**China**
Mean	0.083	1.658	-1.156	0.673
Maximum	0.73	2.506	-0.827	1.086
Minimum	-0.298	1.329	-2.208	0.135
Jarque-Bera	26.99	177.65	294.03	17.177
	(0.000)***	(0.000)***	(0.000)***	(0.000)***
Observations	242	242	242	242
PANEL B: Geopolitical Risk Index				
	Brazil	**Russia**	**India**	**China**
Mean	-0.0006	-0.0005	-0.0004	0.0003
Maximum	0.308	0.442	0.505	0.243
Minimum	-0.364	-0.278	-0.278	-0.21
Jarque-Bera	0.354	22.479	103.351	7.708
Probability	(0.837)	(0.000)***	(0.000)***	(0.021)**
Observations	242	242	242	242

Note: Prob. Value of JB statistics in parentheses.
*** and ** show 1% and 5% level of significance respectively.
Source: Authors' Estimation

The table shows that the mean value for Brazilian equity index is 0.083 with a minimum value of -0.298 and maximum value of 0.730 while the GPR index of brazil take up the mean value of -0.0006 with a minimum value of -0.364 and a maximum value of 0.308. The mean value of Russian equity index is 1.658, with a minimum value of 1.329 and a maximum value of 2.506, whereas, the mean value of the GPR index for Russia is -0.0005 with the maximum value of 0.442 and minimum value of -0.278. For India, the mean value of the equity return is -1.156 with a maximum value of -0.827 and a minimum value of -2.208 and for the GPR index the mean value is -0.0004, maximum value is 0.505 and minimum value is -0.278. At last, for Chinese equity return, the mean value is 0.673 with a maximum value of 1.086 and minimum value of 0.135, whereas, the GPR index

of China takes the mean value of 0.0003, with a maximum value of 0.243 and minimum value of -0.21. Total number of observations for each variable in each country is 242.

The Jarque-Bera statistics for each variable except for the GPR index of Brazil shows that the variables have skewed distribution, hence giving us the motivation for using QQR approach to find out the dependence structure between the equity market returns and GPR index of BRIC countries.

Results and Discussion

The relationship between the quantile of equity market returns and τth quantile of geopolitical risk index are presented in the Figure 1 through 4 and the correlation estimates for low, middle and higher quantiles are presented in Table 2 below. As it can be observed from the figures and table given below, some interesting findings have emerged in the context of BRIC economies. The results broadly confirms that the relationship between geopolitical risk index and equity price returns of BRIC economies is of heterogeneous in nature. This heterogeneity in the dependence structure of GPR index and equity market returns of BRIC countries may be attributed to the varying nature of the geopolitical environment of each country and their dependency on the equity markets. In addition to this, significant differentiation can also be observed between different quantiles of geopolitical risk and equity market returns for each country. It implies that the impact of a geopolitical shock on the equity market depends on the market trend, i.e., if the market is experiencing a bearish or bullish trend.

Table 2

Correlation Estimates between Geopolitical Risk and Equity Returns of BRIC Countries

Equity Returns	**Geopolitical Risk (GPR)**									
	Brazil					**China**				
	Q(0.05)	**Q (0.1)**	**Q(0.5)**	**Q(0.9)**	**Q(0.95)**	**Q(0.05)**	**Q (0.1)**	**Q(0.5)**	**Q(0.9)**	**Q(0.95)**
Q(0.05)	0.765	1.066	2.545	4.475	4.562	-3.466	-3.466	0.238	-1.166	-0.079
Q (0.1)	0.07	-0.059	0.079	0.645	0.298	0.408	-0.975	0.238	-1.166	-0.079
Q(0.5)	-0.222	-0.366	0.168	-0.695	-1.233	0.134	0.127	0.105	-0.136	-0.234
Q(0.9)	0.403	-0.249	-1.566	-4.284	-4.284	0.485	0.265	0.089	0.248	0.129
Q(0.95)	-0.592	-0.592	-3.451	-4.284	-4.284	0.568	0.515	0.178	-1.631	0.125
	India					**Russia**				
Q(0.05)	-0.532	-0.532	-0.23	-0.23	-0.23	-1.167	-1.111	0.131	1.164	1.784
Q (0.1)	-0.532	-0.532	-0.23	-0.23	-0.23	-0.253	-0.426	0.131	0.648	0.401
Q(0.5)	0.126	-0.181	0.004	-0.13	-0.428	0.591	0.727	0.189	0.188	-0.846
Q(0.9)	0.26	0.348	0.229	0.175	0.262	0.011	-0.118	0.204	0.152	0.152
Q(0.95)	1.01	0.734	0.106	1.251	1.005	-0.118	-0.8	0.204	0.152	0.152

Source: Authors' Estimations

Figure 1 shows the relationship between equity price returns and geopolitical risk for Brazilian economy. The results are largely negative for a vast combination of quantiles. Moreover, the intensity of the relationship increases at the higher quantiles of equity prices as compared to lower quantiles, implying that the Brazilian funds reacts more negatively to any geopolitical uncertainty when the market is bullish.

Figure 1
Brazil

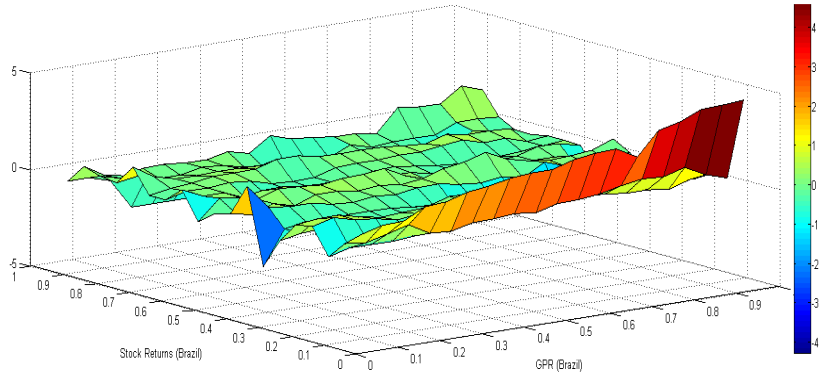


Figure 2 represents the results for Russia. The relationship between the quantiles of equity returns and geopolitical risk index is essentially negative. The results are very much similar to Brazil, as the relationship between equity price returns and geopolitical risk index is more negative when the market is bullish i.e., at the higher quantiles of equity price returns. However, at the lower quantiles of equity returns, or when the equity market is bearish, the intensity of the relationship gets lowered.

The results for Russia and Brazil suggest that the investors of these markets are highly responsive to the any geopolitical uncertainty regardless of its type that whether it is a terror assault, or military action. The results for these two markets are in line with the findings of Balcilar et al. (2018) and Hammoudeh, Sari, Uzunkaya, and Liu (2013), who proposed that these markets are very much sensitive to the geopolitical tensions, and a geopolitical uncertainty may be a driving force for their equity market returns.

Figure 3 shows the results for India. According to the results, the Indian equity market is found resilient to the geopolitical shocks. The results showed that when the market is bearish, even a large geopolitical shock does not create a greater impact on the equity price returns as the magnitude of the coefficient is small for the higher quantiles of geopolitical risk index and lower quantiles of equity returns. Surprisingly, the market also tends to behave positively to a geopolitical shock when it is bullish, i.e., at the higher quantiles of equity returns.

The results for China are presented in figure 4. The results show that the Chinese equity market only responds negatively to the geopolitical uncertainties when it is bearish, as the beta coefficient for the lower quantiles of equity returns and higher quantiles of geopolitical risk index possess negative sign.

Figure 2
Russia

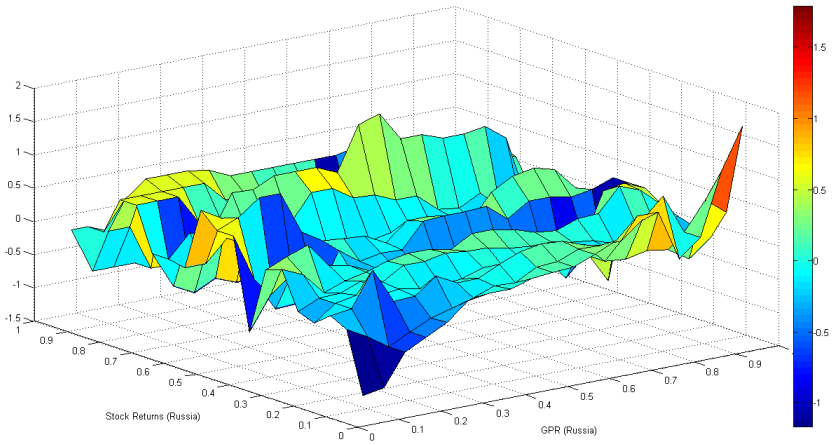
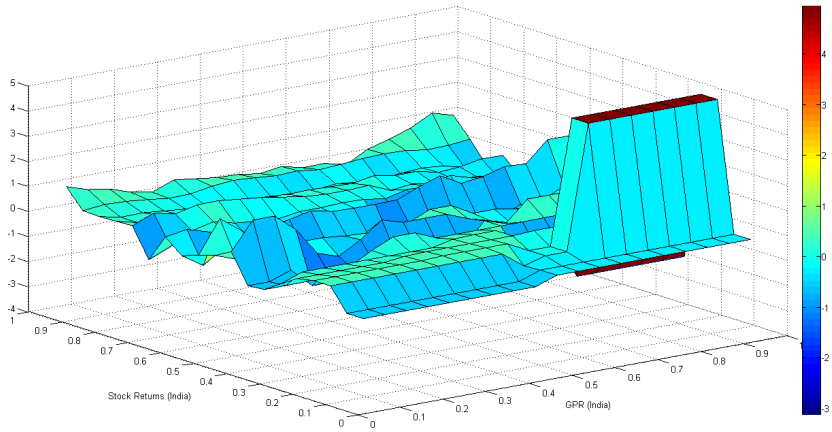


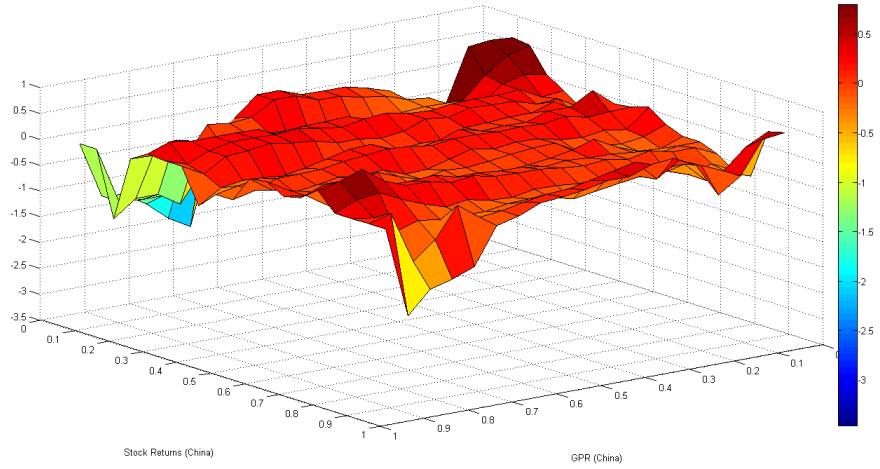
Figure 3
India



However, when the market is bullish, even a larger geopolitical shock fails to lower the returns on equity. In fact, the bullish market continues to behave positively even with a larger geopolitical shock, as the beta coefficient is positive for the higher quantiles of equity returns and higher quantiles of geopolitical risk index. This implies that Chinese funds are largely insulated to the geopolitical shocks.

For China and India, it has been observed that their equity returns are not responsive to the geopolitical uncertainty. This result may be attributed to relatively greater growth of these two economies among the BRIC countries has helped them cushion the adverse effects of geopolitical risk on their equity markets. This idea can get partial support from the findings of Henkel (2012) who noted that the flow of capital in the Indian market due to the boom of IT industry in particular helped it in mitigating the negative effects of geopolitical uncertainty.

Figure 4
China



Conclusions and Policy Recommendations

With the rapidly changing global dynamics, the researchers and policy makers have started showing keen interest in the geopolitical events and their effects on the investments and businesses. It is regarded as one of the main antecedents of taking business and investment decisions. Geopolitical shocks make the investment environment uncertain and can lead to various businesses and investments risks. It does not only disturb the overall economic outlook but, can also lead to volatility in the equity returns. When an economy is subjected to any geopolitical uncertainty, it decreases the investment and consumption. This decrease in the investment and consumption further leads to contraction in the economy that lowers the level of funds available for investment. This phenomenon subse-

quently lowers the equity market performance. We have chosen the emerging economies as the study sample because these economies have acquired an important place in the global economy because of their 'fast paced' growth rate. They are now also being regarded as 'potential hub' for investment purpose, and it is being believed that if investors start diversifying their portfolios by adding the stock of these markets, they can earn greater returns on investment. Therefore, it is important to test the effects of geopolitical risks on the equity markets of the emerging economies. Using this line of thought, the current study tried to assess the same idea for BRIC countries using non parametric quantile on quantile approach. The reason of using this particular approach is that since the risk measures and equity returns have non normal distribution, hence using the conventional mean based approaches to assess their relationship will lead to spurious results. Hence, we have chosen QQR approach to examine our hypothesis as this technique can easily accommodate heavy tails and non-normal distribution of variables.

Our results showed that the emerging markets' equity returns do not show homogenous response to the geopolitical uncertainties. Out of four BRIC economies, Brazil and Russia have depicted a negative relationship between equity market returns and geopolitical risk index implying that their own country geopolitical uncertainties can decrease the equity prices of these economies, hence in times of any geopolitical uncertainty, Brazilian and Russian stocks cannot be used for portfolio diversification.

As far as Indian stocks are concerned, they are found quite resilient to their own country geopolitical tensions as their response to it remained positive, whether the market is bearish or bullish. As for China, the bearish market responded negatively to the geopolitical shocks however, for the bullish market the response is found positive. These results imply that Chinese and Indian funds can be regarded as 'safe haven' for investments even in times of any geopolitical distress. This is an important finding for the local as well as foreign investors who seek to diversify their portfolio in order to maximize their profits and minimize the investment risk.

According to Balcilar et al. (2018), the heterogeneity in the behavior of the stock markets can be attributed to various factors such as the economy's exposure to political and financial uncertainties, exposure of the US dollar in the foreign exchange reserves, strength of domestic demand etc. Moreover, one should also note that geopolitical shocks in general, are unanticipated therefore, the financial sector of the economy should be strong enough that it becomes resilient to any of such exogenous shocks and can help the market to return to a stable position. This is an important implication for the emerging markets. They require to develop their financial sector that can complement their growth potential and decrease the vulnerability of the economies to any geopolitical uncertainty. Therefore, it is strongly recommended for these economies to work on the stability and development of their financial sector. In this way, they may be able to decrease the negative effects of geopolitical shocks on their economies.

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