“The effect of political events on the Pakistan stock exchange 1947-2001”

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Abstract

In this paper, we apply Bayesian hierarchical modelling and Markov Chain Monte Carlo (MCMC) techniques to primary data collected from interviews with 200 prominent historians, economists, politicians, government officials, investors, senior bankers, stock market analysts and other individuals involved in the Pakistani stock markets to measure Pakistan's political risk and its effect on the stock market from 1947 to 2001. We find that the probability of a major political event affecting the stock market in any year is high, averaging 1.5 events per year with a risk premium of between 11.725 and 16.725%. Interestingly, we also find that there is no time trend and thus, that political risk is neither increasing nor decreasing.

Keywords: political risk, rare events, hierarchical Bayesian models, MCMC sampling.
JEL Classification: C23, F30, G15, G31.

Introduction

The purpose of this paper is to measure the level and evolution of political risk in Pakistan from 1947-2001 (the period from independence until the events of 9/11/01) and estimate its effect on the Pakistani stock market in terms of actual losses and in terms of a political risk premium. We look at Pakistan due to its political, economic, and financial importance in a region that has recently emerged as a powerful and dynamic source of world economic and financial activity. Created in 1947, Pakistan is strategically located at the crossroads of Iran, Afghanistan, India, China and the oil soaked sands of the Gulf States. Al Queda, the Taliban and the war on terror are recent developments that have popped Pakistan to prominence on the international political stage. Not so long ago the source of its celebrity was war with India, secession and the atomic bomb. More importantly, however, Pakistan is something of an economic success story. Since the last world war, Pakistan's growth has been the fastest in South Asia. Since 1947 gross national product has increased on average by over 5 percent a year. Pakistan started behind India at the time of independence, but today, in spite of a high rate of population growth, its income per capita is close to 65 percent higher. This prosperity has been nourished by a flourishing stock market. Over the past two decades per capita income and stock market capitalization have more than trebled. Political risk, however, has always been an impediment to Pakistan's prosperity in general and to stock market performance in particular. More recently, however, Pakistan's political risk and its consequences have became the object of intense interest due to Pakistan's high profile role in the war on terror.

As a practical matter, political risk is notoriously difficult to identify and measure, given its heterogeneous nature and irregular arrival patterns[1]. Some authors such as Robock (1971) and Haendel et al. (1975), Kobrin (1979) or more recently Feils and Sabac (2000), focus on political risk as it affects the volatility of an investment's overall profitability both negatively and positively. Other authors such as Root (1973), Simon (1982), Howell and Chaddick (1994), Roy and Roy (1994) and Meldrum (2000) adopt a more practical stance and analyze risk as an explicit negative event that causes an actual loss or a reduction of the investment's expected return. Tests of political risk on investment outcomes reflect these two approaches. Kim and Mei (2001), Chan and Wei (1996), Cutler et al. (1989) and Bittlingmayer (1988) consider political risk with respect to stock market volatility. Other papers, such as Erb et al. (1995 and 1996), Cosset and Suret (1995), Bekaert (1995), and Bekaert and Harvey (1997), Bilson et al. (2001), Clark and Kassimatis (2003), Gendreau and Heckman (2003) and Bandopadhyaya (2005) focus on losses and test political risk with respect to stock market performance.

In this paper we adopt the latter concept of political risk as an explicit negative event that causes a loss or a reduction in the investment's expected return. However, the approach in this paper differs significantly from that of the foregoing literature. The foregoing literature uses either specialist opinion

[1] For example, exchange controls (Aliber, 1973), changes in the political environment (Green, 1974), discontinuities in the business environment (Robock and Simmonds, 1973), transfer risks (potential restrictions on transfer of funds, products, technology and people), operational risks (uncertainty about policies, regulations, governmental administrative procedures which would hinder results and management of operations in the foreign country), and, finally, risks on control of capital (discrimination against foreign firms, expropriation, forced local shareholding, etc.) (Root, 1973). Other distinctions are made between global and specific political risk, macro and micro, soft and hard. Some authors make a further distinction between political risk and country risk where political risk refers to FDI and country risk refers to loans made by commercial banks to developing countries. See Bouchet et al. (2003) for a review of the literature.

contained in ratings and professional analysis or quantitative measures based on macro-economic variables and market data to measure political risk, which is then analyzed with standard regression techniques[1]. In this paper we use interviews with 200 prominent historians, economists, politicians, government officials, investors, senior bankers, and stock market analysts to gather the primary data on the major political events that negatively affected Pakistan's stock markets. We then use Bayesian hierarchical modelling and Markov Chain Monte Carlo (MCMC) techniques to analyze these data. The Bayesian/MCMC approach, to our knowledge the first application of its kind in political risk analysis, is well adapted to the field of political risk where events are rare and data are sparse, conditions that are unsuited to the standard methodologies applied in financial econometrics.

The first contribution of this paper is the introduction of a new approach to political risk analysis based on interviews and Bayesian/MCMC analysis. The second contribution is that this is the first paper to identify and analyze the major political events affecting the Pakistani stock markets. We find that the probability of an event in any year is relatively high with an average arrival rate of 1.5 events per year, that there is no time trend in the arrival rate, thereby suggesting that the frequency of political events is neither increasing nor decreasing over the period and that the premium for this political risk ranges between 10.725 and 16.725%.

The rest of the paper is organized as follows. In section 2 we present the Pakistani stock markets. Section 3 describes the methodology for collecting the data, and the Bayesian/MCMC modeling technique. Section 4 presents the empirical results and section 5 concludes.

1. Pakistani stock market

Pakistan has three stock exchanges. The Karachi Stock Exchange (KSE), established in 1947, is the oldest and most important one, followed by the Lahore Stock Exchange (LSE), set up in (1970), and the Islamabad Stock Exchange (ISE), which commenced its operation in 1992.

After its founding on September 18, 1947, the Karachi Stock Exchange (KSE) was converted and registered as a Company Limited by Guarantee on March 10, 1949. Initially, 90 members were enrolled. However, only half a dozen of them were active as brokers. Similarly only 5 companies were listed with a paid up capital of Rs. 37 million. Now the KSE has emerged as the key institution of the capital market of Pakistan (see Meenai, 2001). Table 1 below gives the development of the stock exchange from 1950 to 2000.

Table 1. Progress from 1950 to 2000 of the Karashi Stock Exchange

DECADE-WISE PROGRESS			
Year	No. of listed companies	Listed capital (Rs. in million)	Market capitalization (Rs. in million)
1950	15	117.3	-
1960	81	1,007.7	1,871.4
1970	291	3,864.6	5,658.1
1980	314	7,630.2	9,767.3
1990	487	28,056.0	61,750.0
2000	762	236,458.5	382,730.4

The KSE began with an index composed of 50 companies. As the market grew a representative index was needed. On November 1, 1991 the KSE-100 was introduced and remains to this date the most generally accepted measure of the Exchange. The KSE-100 is a capital weighted index and consists of 100 companies representing about 88 percent of the Exchange's market capitalization. It was recomposed in November 1994. In 1995 the need was felt for an all share index to reconfirm the KSE-100 and also to provide the basis of index trading in futures. The KSE All Share Index was introduced in September, 1995[2].

In Figure 1 we can see that the financial performance of the KSE was relatively flat until December 2001. Since then there has been an almost exponential increase. This counterintuitive fact, given the context of the international financial scene and Pakistan's particular political situation, has a very simple explanation. After 9-11 many wealthy investors and businessmen of Pakistani origin living in the west perceived subsequent events and policies as a possible threat to their financial futures and feared the daunting prospect of having their assets frozen. Therefore, there was a large influx of capital back to Pakistan. Acquainted with the financial developments of the western world, these investors preferred to put their money into the domestic stock exchange rather than deposit them in the banks.

[1] For developed countries the literature on the effect of political risk on stock market performance relies more explicitly on pure political variables. For example, Santa Clara and Valkonov (2003) for the US and Dopke and Pierdzioch (2006) for Germany use information on elections and government orientation.

[2] The total number of listed companies in the relevant year have been stated after 9 companies delisted in year 1998, 5 companies in 1999, 5 companies in 2000, 12 companies in 2001 and 24 companies in 2002 and 5 in 2003 and 6 companies merged in year 1997, 2 companies in 1998, 3 companies in 1999, 1 company in 2000, 7 companies in 2001, 16 companies in 2002, 2 in 2003 and addition of 2 companies by splitting/bifurcation in year 1998 and 1 company in year 2001 (see Khan, A.H. and L. Hasan, 2001).

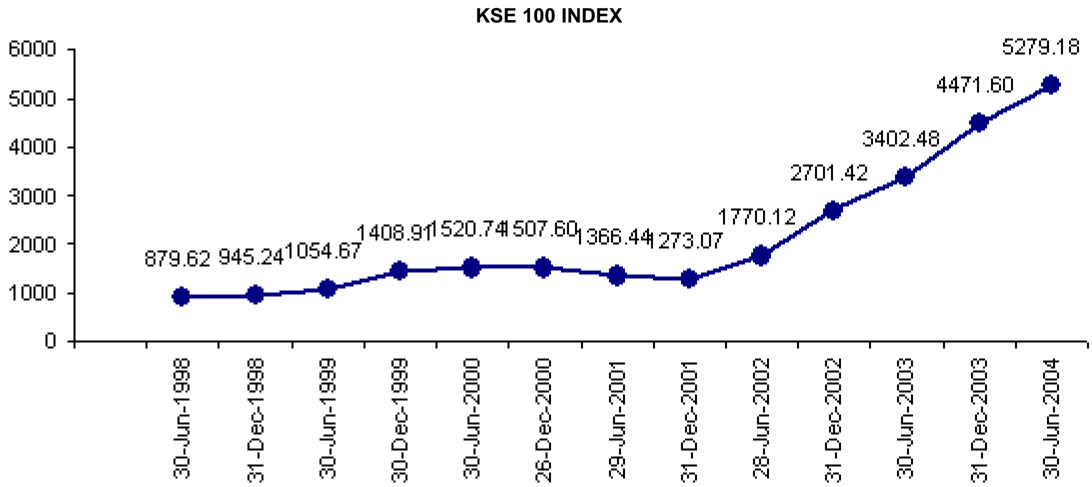

Fig. 1. Recent evolution of stock market index in Pakistan

Table 2 below shows the development of Pakistan's three exchanges since 1991. The number of listed companies on the KSE grew from 497 in 1991 to 762 in 2000 showing an increase of 53 percent, although in the latter half of the decade, the number of listed companies declined by about 3 percent. Paid-up capital grew from Rs. 90 billion in 1991 to Rs. 391 billion by 2000 while trade volumes grew from Rs 361 billion to Rs 48,109 billion, mainly due to the automation of the stock exchanges and establishment of Central Depositary Company of Pakistan Ltd (CDC).

Companies listed at the Lahore Stock Exchange (LSE) almost doubled from 332 in 1989 to 616 in 2000, as shown in the table. However, much of this progress occurred by 1995, when 617 companies were enlisted. The remaining half decade showed little progress. Nevertheless, paid up capital rose consistently during this period

The Islamabad Stock Exchange (ISE) commenced its operation in August 1992, mainly as a means for catering to investors' needs in the northern region of the country. The ISE, in comparison with the rest of exchanges, is quite small and, in fact, follows the other exchanges. By 2000, 283 companies with a paid up capital of Rs. 162.2. billion were listed on this exchange (see Ul Haque, Nadeem, 2002).

Table 2. Performance of Pakistani stock exchanges

Year	KSE			LSE			ISE		
	No. of listed co.	Trading volume	Paid-up capital	No. of listed co.	Trading volume	Paid-up capital	No. of listed co.	Trading volume	Paid-up capital
1991	497	361	90	417	41.4	30	-	-	-
1992	596	725	218	505	48.1	50	-	-	-
1993	652	894	214	552	85.2	59	58	9	26
1994	683	1,831	404	570	369	77	201	37	36
1995	746	2,293	293	617	959	99	244	82	65
1996	783	5,232	365	640	2,564	119	72	154	84
1997	782	8,023	496	645	2,775	184	283	115	92
1998	779	15,004	259	631	5,848	186	285	478	149
1999	769	25,533	289	621	9,798	186	284	1,802	150
2000	762	48,109	391	616	16,356	207	283	3,139	162

Source: State Bank of Pakistan.

2. Data and methodology

2.1 Data. The data presented in Table 3 were collected using a survey based methodology of interviews with 200 prominent individuals[1] in Pakistan who were asked to identify the most important negative events influencing the Pakistani stock market since the creation of the country and to evaluate the severity of those events[2]. Severity was divided into 3 levels: Level 1: 8% or less; Level 2: greater than 8% but less than or equal to 16%; Level 3: greater than 16%. The results of this survey were tabulated and circulated back to the interviewees until a consensus was reached. The events included in Table 3 are those on which all individuals agreed.

Table 3. Major political events negatively influencing the Pakistani stock market (1947-2001)

Political event	Severity table
1947 Creation of Pakistan	2
Quid-e-Azam became Governor General (1)	1
1948 War with India	3
1951 Liaquat Ali Khan was assassinated	1
1955 First ever five year economic plan (2)	1
1956 First constitution (3)	1
1958 First martial law by Ayub Khan	3
1965 War with India	3
1969 Second martial law by Yahya Khan	2
1970 Election with Awami party and Peoples party (4)	2
1971 War with India	1
Separation of East Pakistan	1
Civil war	1
1972 Simla Agreement	1
POW 90,000	1
1973 New constitution	1
1977 Third martial law by Zia	2
Bhutto prisoner	1
1979 Butto Hanged till death	1
1985 Election and Jenajo became Prime minister (6)	1
1988 Jenajo Government dissolved and Zia died	1
Benazir became Prime minister	1
1990 Benazir dismissed and assemblies dissolved by GIK	2
Nawaz Sharif was made prime minister	1
1992 Biggest floods in history of Pakistan	2
1993 Nawaz Shrif government dismissed and Benazir was elected for the second time	1
1996 Benazir government dissolved	1
1997 Nawaz Sharif elected again	1
1998 Pakistan became nuclear power/Banks fixed	1
1999 Kargil war	2
Mushrraf came in power	1
2001 Sep. 11	
America banned aid to Pakistan	1

Notes 1-6 explain why certain events had a negative impact on the stock market: 1) 1947 when Pakistan was created it was India's division as well as British leaving therefore it was chaos overall and markets reacted with level 3 severity. 2) 1955 It was the first ever economic plan and was not popular among businessmen and investors and as a result there was even a change in Prime Ministership. Markets reacted with level 1 severity. 3) 1956 Again the first ever constitution was highly unpopular since it was very different from the previous constitution set by the British and therefore needed to be amended several times. Markets reacted with level 1 severity. 4) 1970 The election of Awami party in East Pakistan and Peoples party in West Pakistan lead to the eventual break-up of Pakistan a few months later. Markets reacted with level 2 severity. 5) 1973 The constitution was very unpopular since this was the 1st one after break up of Pakistan and the Peoples party had nationalized all the industry in Pakistan by then. Therefore the investment and markets had no confidence. Markets reacted with level 1 severity. 6) 1985 Pakistan's economy has done well under military dictatorship. Under General Zia the economy was very stable so when elections were held under western pressure the Pakistani investors and markets reacted negatively. Markets reacted with level 1 severity.

The interviews identified 33 events over the period: twenty-three level 1 events, seven level 2 events, and three level 3 events. There were 31 individual years when no events were recorded, seventeen years with one recorded event, six years with two recorded events and one year with three (1971).

2.2. The Bayesian/MCMC Methodology. *2.2.1. The Basic Model.* Political events are rare by definition, which means that data are sparse. Since standard methodologies applied in financial econometrics require large quantities of data, they are generally not suitable for studying political events. However, Bayesian modelling coupled with Markov Chain Monte Carlo techniques can overcome this problem to extract inference. However, this huge jump in flexibility comes at a cost, since a non-standard model may be difficult to fit. Here is where MCMC proves itself as one of the best computational engines in applied statistics. The procedure can be outlined as follows.

In Bayesian hierarchical modelling the model is specified on several layers, which makes it possible to capture the uncertainty involved at each layer. For

[1] Prominent individuals include: Historians, economist, politicians, government officials, investors, senior bankers, stock markets analyst and those individuals which play a major role in influencing the Pakistani stock markets.

[2] The survey was conducted in the first instance by mail and telephone to arrange appointments and supply the questions. The first iteration of data collection was conducted by face to face interviews. Subsequent iterations were conducted by mail and telephone. The two questions relevant to this study were 1) What are the most important political events that negatively affected the stock market since 1947? 2) Rate the effect on a scale of Level 1: 8% or less; Level 2: greater than 8% but less than or equal to 16%; Level 3: greater than 16%.

example, generically denoting the vector of all data by y, the vector of all parameters by φ[1] and a probability density function by p, we first provide a likelihood distribution $p(y \mid \varphi)$ and an a priori distribution for the parameters $p(\varphi)$. Then, using Bayes' law it is true that

$$p(\varphi \mid y) \propto p(y \mid \varphi) p(\varphi), \qquad (1)$$

where the $\propto$ signifies that the relationship is true up to a proportionality constant. This process may continue hierarchically with further prior parameters associated with φ. The models in this paper are all Bayesian. Good reviews of this type of modelling are provided in Gelman et al. (1995), Gilks et al. (1996) and Lancaster (2004).

For example, in this paper we assume that the rate at which political events occur follows a conditional Poisson process, which has one parameter that must be estimated[2]. This is the first layer. In the second layer, we recognize that the arrival rate of the Poisson process can also be a random variable. We assume that this variable has a Gamma distribution[3]. A Gamma distribution has two parameters that must be estimated. In the third layer we recognize that the two parameters of the Gamma distribution can also be random variables. We assume that each of these parameters has a Gamma distribution. This is the last layer and requires the estimation of four parameters (two for each of the two Gamma distributions), which are constants and not random variables.

Thus, the inference process involves defining the model and specifying the parameters. The Poisson-Gamma model (PG) described above can be written more formally as follows

$$\begin{aligned} &Y_i \mid \theta \sim Pois(\theta) \\ &\theta \mid \alpha, \beta \sim Gamma(\alpha, \beta) \\ &\alpha \sim Gamma(a_1, a_2) \quad \beta \sim Gamma(b_1, b_2), \end{aligned} \qquad (2)$$

where a_1, a_2, b_1, b_2 are constants that are chosen in order to specify the degree of information that the analyst has about the parameters α and β. Since most of the time there is no precise information available, these values must be chosen such that the resulting Gamma distribution has a wide range of likely values. The model postulates that the number of events in each year is conditionally independent draws from the same Poisson distribution with arrival rate θ, which is also a random draw from a Gamma distribution with parameters α and β.

For this model the joint posterior distribution of *all* parameters is

$$\begin{aligned} &p(\theta, \alpha, \beta \mid y) \propto p(y \mid \theta) p(\theta \mid \alpha, \beta) p(\alpha) p(\beta) \\ &\propto \left[\prod_{i=1}^{N} \frac{\theta^{y_i} e^{-\theta}}{y_i!} \right] \left[\frac{\beta^{\alpha}}{\Gamma(\alpha)} \theta^{\alpha-1} e^{-\theta\beta} \right] \left[\alpha^{a_1-1} e^{-\alpha a_2} \right] \left[\beta^{b_1} e^{-\beta b_2} \right] \end{aligned} \qquad (3)$$

The marginal posterior distribution for each parameter (or group of parameters) of interest can be identified by collecting all factors containing that parameter from the joint posterior distribution. Thus

$$\begin{aligned} &p(\theta \mid y, \alpha, \beta) \propto \theta^{\sum_{i=1}^{N} y_i + \alpha - 1} e^{-\theta(\beta+1)} \propto Gamma\left(\sum_{i=1}^{N} y_i + \alpha, \beta + 1\right) \\ &p(\alpha \mid y) \propto \frac{(\beta\theta)^{\alpha}}{\Gamma(\alpha)} \alpha^{a_1-1} e^{-\alpha a_2} \\ &p(\beta \mid y) \propto \beta^{\alpha+b_1-1} e^{-\beta(\theta+b_2)} \propto Gamma(\alpha + b_1, \theta + b_2) \end{aligned} \qquad . \qquad (4)$$

In order to obtain inference, we use the Markov Chain Monte Carlo (MCMC) simulation technique to sample from values from the posterior distributions. The first step is to ensure that the simulated chain or chains are stationary. Although it is theoretically impossible to be 100% sure that the chain has converged, a series of tests, measures and exploratory graphical investigations are conducted prior to any inferential calculations. Figure 2 (a) shows the autocorrelation plots. If the simulated Markov Chain is mixing very slowly, i.e. it is sticky at some part of the distribution but fails to cover its proper range, the plots will indicate a high degree of autocorrelation for large lags. Here it is obvious that there is no such problem.

Another way to check that stationarity has been reached is to calculate the Gelman-Rubin statistics (Gelman & Rubin, 1992), as generalized by Brooks and Gelman (1998), and illustrated in Figure 2 (b). Two chains were used starting from overdispersed values and the inference sample is sometimes thinned (taking every 5th value from the sample) so that more independent values from the posterior densities are employed for calculations. Convergence is indicated by the fact that the parallel lines say together in a very narrow band around the level of 1. Perhaps the crudest

[1] A missing data observation can be considered as a parameter in the context of Bayesian modelling.

[2] It is conventional in the finance literature to model discrete events as Poisson processes.

[3] The Gamma distribution has the advantage of being flexible with respect to shape and can capture effects such as skewness. It also has the technical advantage that when combined with a Poisson distribution, the result is another Gamma.

method of inspection of whether the simulated chain has converged is to look at the multiple chain trace plots for the monitored nodes.

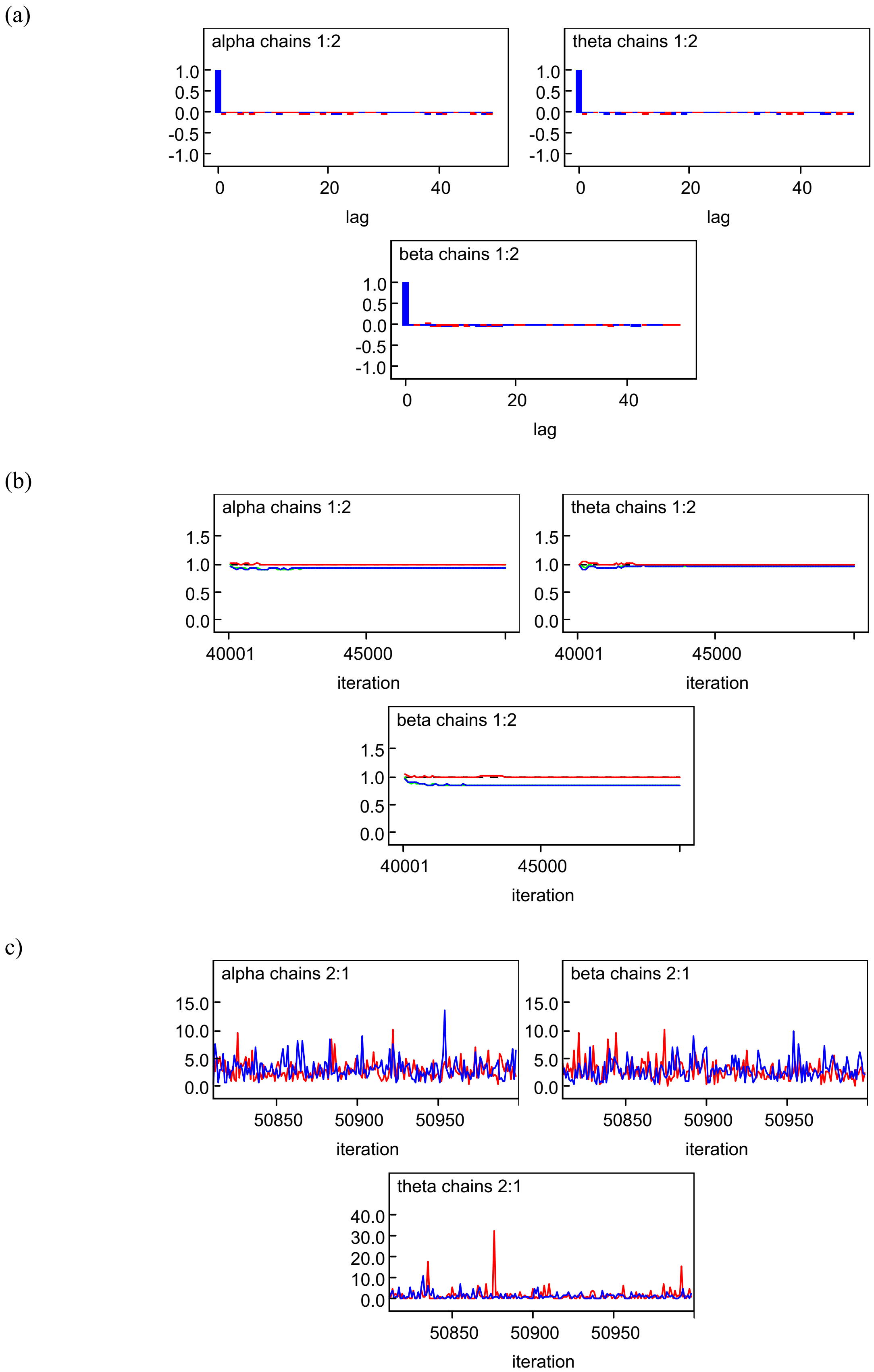

Fig. 2. Convergence tools for monitoring stationarity of MCMC

This type of plot is exhibited in Figure 2 (c). Lack of convergence is indicated when the paths of different simulated chains are going in totally different directions or when there is no direction of stability, such as the chain going always upwards for example. Here it seems that there is no problem with convergence and therefore inference can be extracted from a sample simulated after this burn-in period.

The results reported below for the models we use were obtained after a burn-in period of 40000 iterations[1].

2.2.2. Testing for a time trend. To determine whether our data reflect a time trend, we follow the procedure as outlined above but use a model called Poisson with Time Trend in the arrival rate (PTT):

$$\begin{aligned} &Y_i \mid \theta_i \sim Pois(\theta_i) \\ &\ln \theta_i = a + bi \\ &a \sim N(0,0.0001) \quad \mathrm{b} \sim N(0,0.0001) \end{aligned} \tag{5}$$

The last line of the model specification acknowledges our lack of any prior information about the regression coefficients that are treated as random variables. The parameterization of the normal distribution is in terms of precision, which is the inverse of variance. Implemented in this way, a very small precision means a very large variance leading to a very flat normal distribution similar to a uniform distribution over a very large range. The joint posterior distribution of the parameters of interest, the regression coefficients *a* and *b* here, is

$$p(a,b \mid y) \propto p(y \mid a,b)p(a)p(b) \propto \left[\prod_{i=1}^{N} \frac{(a+bi)^{y_i} e^{-a+bi}}{y_i!}\right]\left[e^{-\frac{0.0001}{2}a^2}\right]\left[e^{-\frac{0.0001}{2}b^2}\right]. \tag{6}$$

3. Empirical results

3.1. The MCMC. The significant advantage of MCMC is that once a sample is available from the posterior distribution of all parameters then it is straightforward to calculate any function statistic. Table 4 gives the results for the GP model from the Pakistani sample data for the mean, the standard deviation, the median and the quantiles defining the 95% credibility interval of theta, the arrival rate. The whole posterior distribution of this parameter is depicted in the Appendix, together with the posterior distribution of the other two parameters, alpha and beta, describing the model.

Table 4. Posterior estimation for the Poisson-Gamma Model

Node	Mean	St. dev.	2.5%	Median	97.5%
alpha	2.995	1.735	0.6268	2.669	7.304
beta	3.012	1.735	0.6211	2.679	7.195
theta	1.481	2.136	0.0344	0.884	6.629

Note: mean, standard deviation, median and the quantiles defining the 95% credibility interval of the parameters.

As might be expected, the level of political risk in Pakistan is very high with an average of nearly 1.5 events per year as indicated by the parameter theta. The median confirms this and suggests an arrival rate of almost one event per year. The high frequency of political events means that political risk cannot be ignored when building portfolios that contain a Pakistani component. For example, a simple diffusion model would not be adequate to capture the movements in the Pakistani stock prices. An appropriate model would have to include the discrete jumps caused by the political events or the effect of political events would have to be modelled separately and incorporated in the analysis as in Clark (1997)[2].

The next question we ask is whether there is any time trend in the arrival of political events that impact the Pakistani stock markets. For this we use the PTT model and look at the coefficient of *b*. If the coefficient of time *b* has a credibility interval that does not include the value 0 then it is significant. The same principle applies to any parameter of interest.

Table 5. Posterior estimation for the Poisson Model with Time Trend in arrival rate

Node	Mean	St. dev.	2.5%	Median	97.5%
a	-0.2943	0.3055	-0.9215	-0.2812	0.2720
b	0.0040	0.0092	-0.0140	0.0040	0.0227
mu_a	-0.2952	0.7646	-1.8100	-0.2932	1.2170
mu_b	0.0046	0.7071	-1.3950	0.0091	1.4300
v_a	3.0070	1.7260	0.6414	2.6890	7.1810
v_b	3.0040	1.7300	0.6299	2.6780	7.2560

Note: mean, standard deviation, median and the quantiles defining the 95% credibility interval of the parameters.

[1] Note that this sample is made of values that are correlated. Nonetheless the sample is large enough to cover the whole density range and the lack of independence does not affect in any way the inference. If some sort of independence in the sample is desired then the sample can be thinned by retaining from the sample every k-th value.

[2] Jump-diffusion models and Levy processes can capture the effects of discrete jumps. For some recent papers on jump-diffusion processes in financial application see: Derivative Securities and Risk Management Conference organized by FDIC (Federal Deposit Insurance Corporation) in Washington, DC.: http://www.fdic.gov/bank/analytical/cfr/2008_Derivatives_and_Risk_Mgmt_Conf.html

Table 5 shows that the 95% confidence interval for the coefficient b contains zero, and thus we may conclude that this coefficient is not significant. Therefore there seems to be no time trend in the arrival rate of political events in Pakistan. This means that political risk has also been relatively stable over the period but it has been relatively high.

3.2. The risk premium for political risk. We now combine event frequency estimated above with the information on event severity resulting from the interviews to get an estimate of the cost of political risk in terms of a risk premium. To calculate the risk premium for political risk, we follow Clark (1997) where the cost of political risk is measured as the value of a hypothetical insurance policy that pays all losses due to political events and the value of the investment is equal to its value estimated without political risk minus the value of the insurance policy[1]. Consider the following notation

V – the theoretical value of the stock market in the absence of political risk;

I – the value of the stock market observed with political risk;

v – the value of the hypothetical insurance policy for political risk;

R – the required rate of return on the stock market;

α – the growth rate of the value of the stock market;

r – the risk free rate of interest;

$\alpha*$ – the risk neutral growth rate;

δ – the dividend rate on the stock market, which we assume is a policy variable and is known;

J – the percentage of the stock market value that is lost when a political event happens.

Thus, following Clark (1997)

$$V = I + v \tag{7}$$

and, ruling out speculative bubbles and assuming that the insurance policy cannot be cashed in,

$$v = \frac{\lambda J I}{\delta}, \tag{8}$$

where $\delta = r - \alpha*$.

[1] Clark (1997) uses a jump-diffusion process. For some recent papers on jump-diffusion processes in financial application see: Derivative Securities and Risk Management Conference organized by FDIC (Federal Deposit Insurance Corporation) in Washington, DC.http://www.fdic.gov/bank/analytical/cfr/2008_Derivatives_and_Risk_Mgmt_Conf.html

The observed stock market value can be written as

$$I = \frac{\delta I}{\delta}, \tag{9}$$

where $\delta = R - \alpha$ ($r - \alpha* = R - \alpha$ because δ is a policy variable).

Substituting (8) and (9) into (7), taking the risk adjusted expression of δ($\delta = R - \alpha$) and rearranging give

$$(R - \alpha)V = I(R + \lambda J - \alpha). \tag{10}$$

From (10) we can see that the risk premium due to political risk is equal to λJ. Based on the foregoing MCMC results, we estimated that $\lambda = 1.5$. J is the average loss due to the political events cited above. To estimate J, we used the severity levels reported in Table 3. We used the midpoint of each interval (4%, 12% and 20%) to establish the floor and the maximum value (8%, 16% and 24%) to establish the ceiling. We find that J ranges between 7.15% and 11.15%[2]. Using this methodology, we estimate that J, the average size of a loss due to a political event is between 7.15% and 11.15% of the value of the stock market. Thus, we find that the risk premium due to political risk λJ is between 10.725% and 16.725%.

Conclusions

In this paper we have identified the major political events that influenced Pakistan's stock market between 1947 and 2001 by collecting primary data in the form of questionnaires from prominent historians, economists, politicians, government officials, investors, senior bankers, stock market analysts and other individuals involved in the Pakistani stock markets. We then analyzed the data using Bayesian modelling and Markov Chain Monte Carlo (MCMC) techniques. We find that the probability of an event in any year is relatively high with an average arrival rate of approximately 1.5 events per year. Interestingly, we find that there is no time trend in the arrival rate, thereby suggesting that the frequency of political events is neither increasing nor decreasing over the period. Finally, we estimate that the risk premium due to political risk is very large, lying somewhere between 10.725% and 16.725%.

[2] As a robustness check we also looked at each event identified in the interviews and calculated the loss it generated. Because of the nature of certain events that in some cases played out over a period of time, it was not possible to assume that all stock market movements were due solely to the event in question. In cases such as these, we used the severity levels to establish limits. For example, if the severity level was designated as level 1 and the market lost 10% of its value over the event period, we estimated the loss as 8%, the maximum for level 1. On the other hand, if the observed return over the event period was lower than the lower limit of severity level we estimated the loss as the lower limit of the severity level. The results are similar to those reported in the text.

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Appendix

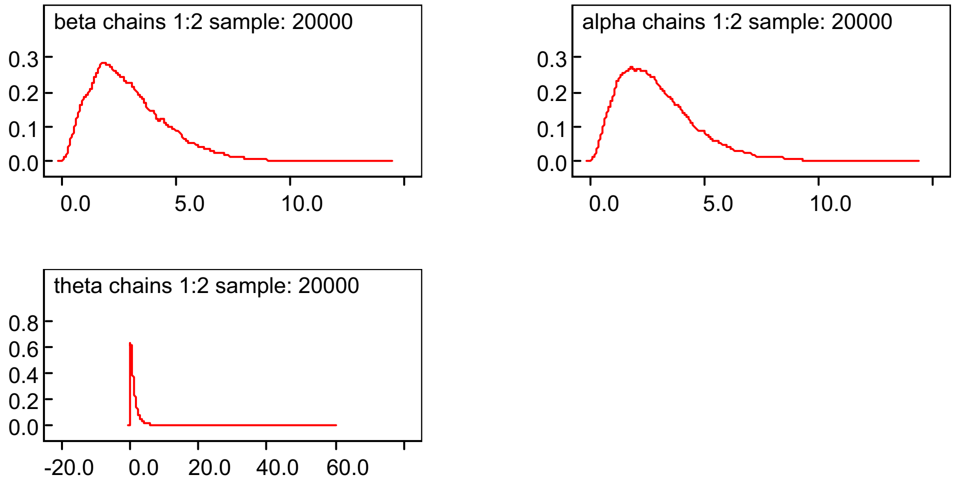

Fig. 1. Posterior densities of parameters of Poisson-Gamma Model

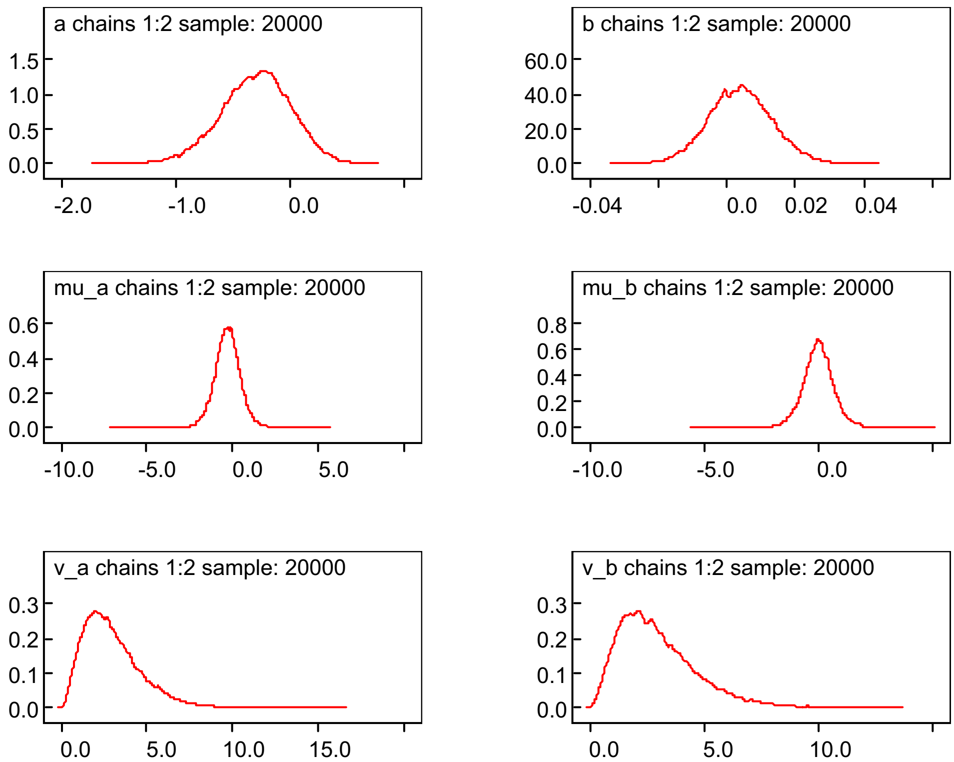

Fig. 2. Posterior densities of all parameters of interest for the Poisson Model with time trend in the arrival rate