How political risks and events have influenced Pakistan's stock markets from 1947 to the present

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Abstract

In this paper, we analyse Pakistan's political risks and events that have affected the country's stock markets since 1947. We collected data in the form of questionnaires from historians, economists, politicians, government officials, bankers and stock market analysts in Pakistan and make forecasts using Bayesian hierarchical modelling and Markov Chain Monte Carlo (MCMC) techniques. Findings show that the probability of an event in any year is relatively high with an average arrival rate of 1.5 events per year with no time trend. In addition, forecasts suggest that the level of political risk should be remaining unchanged for the foreseeable future. Finally, we find that Pakistan's political risk carries a risk premium of between 7.5% and 12%.

1 Introduction

Political events can have a dramatic effect on stock market performance. Consider, for example, the currency and debt crisis of 1982 caused nearly a decade of depressed stock markets and economic hardship in most of the indebted developing countries. For instance, Mexico's stock market index dropped by 38.7% from December 1994 to February 1995. From 1 July 1997 to 16 February 1998 during the Asian crisis, Thai stocks fell by 48.4%, Indonesian's by 81.7%, Malaysian's by 58.4%, Philippines by 49.2% and Korean's by 63.1%. The Russian financial crisis of August 1998 caused a stock market decline of 41.3%. The International Monetary Fund (IMF) (1998) estimated that a severe currency crisis causes an 8% cumulative loss of real output in emerging economies.

In this paper, we look at Pakistan and the political events that have affected its stock markets. We measure Pakistan's political risk and its evolution since independence with respect to the stock market and estimate the cost of this risk in terms of a financial risk premium. In fact, Pakistan is a country particularly suited to political risk analysis. Created in 1947, it 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, 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% 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 60% higher than its neighbour. Pakistan's prosperity has been nourished by a flourishing stock market. Over the past two decades, per capita income and stock market capitalisation 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 become the object of intense interest owing to Pakistan's high profile role in the war on terror. There are two major opinions for the definition of political events. 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 experts such as Root (1973), Simon (1982), Howell and Chaddick (1994), Roy and Roy (1994) adopt a more practical stance and analyse risk as an explicit negative event that causes an actual loss or a reduction in the investment's expected return. Tests of political risk on investment outcomes reflect these two approaches. Kim and Mei (2001), Chan and Wei (2002), Cutler et al. (1989) and Bittlingmayer (1988) consider political risk with respect to stock market volatility. Other papers, such as Erb et al. (1995, 1996), Cosset and Suret (1995), Bekaert (1995) and Bekaert and Harvey (1997), focus on losses and test political risk with respect to stock market performance. In this paper, we adopt the second perspective and focus on political risk as an explicit negative event that causes a loss or a reduction in the investment's expected return.

As Bouchet et al. (2003) have emphasised, political risk is notoriously difficult to identify and measure, given its heterogeneous nature and irregular arrival patterns. Identification of political risks is especially difficult and requires an in-depth knowledge of a country's customs and traditions as well as its political, economic and social organisation. For Pakistani political risk, we identify the major political events that have influenced Pakistan's stock market since 1947 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 analyse this data and make forecasts using Bayesian hierarchical modelling and Markov Chain Monte Carlo (MCMC) techniques. 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 is sparse, conditions that make the standard methodologies applied in financial econometrics unsuitable.

We offer several contributions to the literature. First, we identify the major political events that affected the Pakistani stock markets since 1947. Second, 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. Third, 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, forecasts based on the latest data suggest that the level of political risk will remain unchanged for the foreseeable future. Finally, we estimated the cost of Pakistan's political risk in terms of a financial risk premium.

The rest of the paper is organised as follows. In Section 2, we present the Pakistani stock markets. Section 3 describes the methodology for collecting the data, the data, and the Bayesian/MCMC modelling technique. Section 4 presents the empirical results and Section 5 gives final remarks.

2 Pakistani stock market

Pakistan has three stock exchanges. The Karachi Stock Exchange (KSE), established in 1947, is the oldest and most important, 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 18 September 1947, the KSE was converted and registered as a Company Limited by Guarantee on 10 March 1949. Initially, 90 members were enrolled. However, only half a dozen of them were active as brokers. Similarly, only five 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, 2005). Table 1 gives the development of the stock exchange from 1950 to 2000 and 2007.

Table 1 Progress from 1950 to 2007 of the Karachi Stock Exchange Decadewise progress

Year	No. of listed companies	Listed capital (Rs. in million)	Market capitalisation (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 1 November 1991, the KSE-100 was introduced and remains to this date as the most generally accepted measure of the Exchange. The KSE-100 is a capital weighted index and consists of 100 companies representing about 88% of the Exchange's market capitalisation. 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 (Khan and Lubna, 2001)[1].

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 11 September, 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 depositing them in the banks.

Figure 1 Recent evolution of stock market index in Pakistan

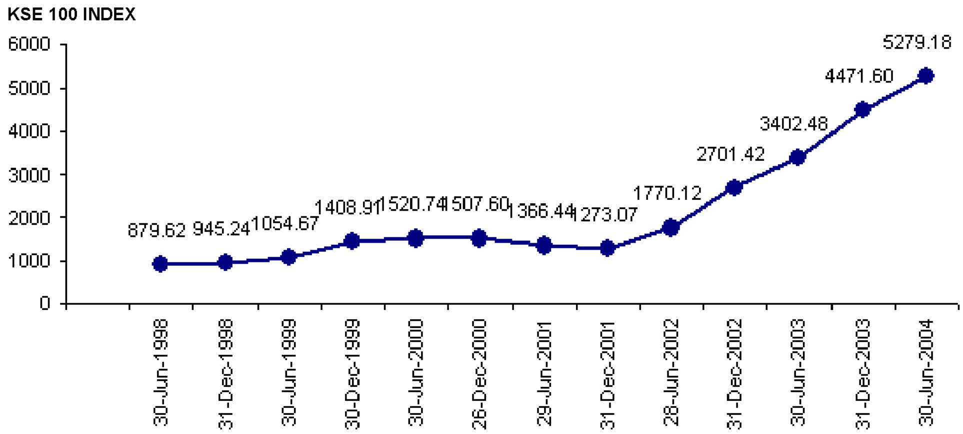


Table 2 shows the development of Pakistan's three exchanges since 1991. The number of listed companies in the KSE grew from 497 in 1991 to 762 in 2000 showing an increase of 53%, although in the latter half of the decade, the number of listed companies declined by about 3%. Paid-up capital grew from 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 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 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 the 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 in this exchange (see Ul Haque, 2002).

Table 2 Performance of Pakistani stock exchanges

		KSE			LSE			ISE	
Year	No. listed Co.	Trading volume	Paid-up capital	No. listed Co.	Trading volume	Paid-up capital	No. listed Co.	Trading volume	Paid-up capital
1992	497	361	90	417	41.4	30	–	–	–
1992	596	725	218	505	48.1	50	–	–	–
1993	652	894	214	552	85.2	59	158	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	272	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	431	16,356	207	283	3,139	162
2001	701	23,786	321	446	17,243	289	289	3,379	223
2002	661	59,6763	437	489	22,567	384	292	3,856	301
2003	661	15,6565	763	501	18,673	684	315	4,210	541
2004	652	17,4094	1,418	518	21,356	1315	318	4,940	1106
2005	656	33,6688	2,215	523	25,453	1396	338	7,980	1159

Source: State Bank of Pakistan

3 Data and methodology

3.1 Data

The data presented in Table 3 was collected using a survey-based methodology from 200 prominent individuals[2] in Pakistan who were asked to identify events in the history of Pakistan, which have influenced the Pakistani stock market [3]. From the data collected, we were able to identify the major events starting from 1947.

Table 3 Major political events negatively influencing the Pakistani stock market*

1947	Creation of Pakistan/Quid-e-Azam became Governor General1
1948	War with India
1951	Liaquat Ali Khan was assassinated
1955	First ever five year economic plan 2
1956	First constitution 3
1958	First martial law by Ayub Khan
1965	War with India
1969	Second martial law by Yahya Khan
1970	Election with Awami party and Peoples party 4
1971	War with India/Separation of East Pakistan/civil war
1972	Simla Agreement/POW 90,000
1973	New constitution5
1977	Third martiall law by Zia/Bhutto prisoner
1979	Bhutto Hanged till death
1985	Election and Jenajo became Prime minister 6
1988	Jenajo Government dissolved and Zia died/Benazir became Prime minister
1990	Benazir Dismissed and assemblies dissolved by GIK and Nawaz Sharif was made Prime Minister
1992	Biggest floods in history of Pakistan
1993	Nawaz Sharif government dismissed and Benazir was elected for the second time
1996	Benazir government dissolved
1997	Nawaz Sharif elected again
1998	Pakistan became nuclear power/Banks fixed
1999	Kargil war/Mushraf came in power
2001	11 September/America banned aid to Pakistan
2002	Election held
2006	Massive earthquake

*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 the Prime Minister. Markets reacted with level 1 severity.

3) 1956: Again the first ever constitution was highly unpopular since it is 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 led 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 first one after break up of Pakistan and the Peoples party had nationalised 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.

3.2 The Bayesian/MCMC methodology

Political events are rare by definition, which means that data is 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 MCMC techniques can overcome this problem to extract inference. Bayesian modelling gives the flexibility, essentially making it possible to design any model with common sense as the only restriction. 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. For example, generically denoting the vector of all data by y, the vector of all parameters By φ[4] 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 $\propto$ 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.

The inference process involves defining the model and specifying the parameters. For example, the Poisson-Gamma (PG) model could be defined as follows

$$\begin{aligned} &Y_i \mid \theta \sim \text{Pois}(\theta) \qquad (2)\\ &\theta \mid \alpha, \beta \sim \text{Gamma}(\alpha, \beta)\\ &\alpha \sim \text{Gamma}(a1, a2)\ \beta \sim \text{Gamma}(b1, b2) \end{aligned}$$

where $a1$, $a2$, $b1$, $b2$ are constants that are chosen 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 are 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

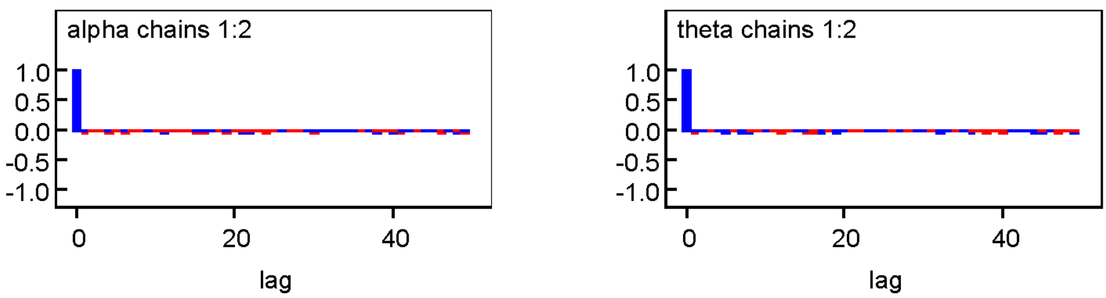
$$\begin{aligned} p(\theta, \alpha, \beta \mid y) &\propto p(y \mid \theta) p(\theta \mid \alpha, \beta) p(\alpha) p(\beta) \\ &\propto \left[\prod_{i=1}^{N} \frac{\theta^{y_i} e^{-\theta}}{y_i!}\right]\left[\frac{\beta^{\alpha}}{\Gamma(\alpha)} \theta^{\alpha-1} e^{-\theta\beta}\right]\left[\alpha^{a_1-1}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

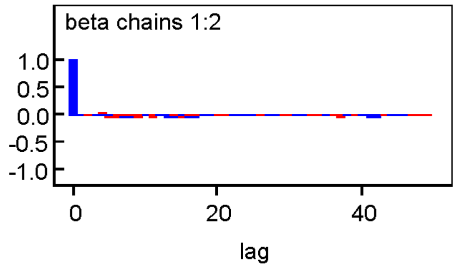
The marginal posterior distribution for each parameter (or group of parameters) of interest can be identified by collecting all factors containing that parameter from the joint posterior distribution. Thus

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

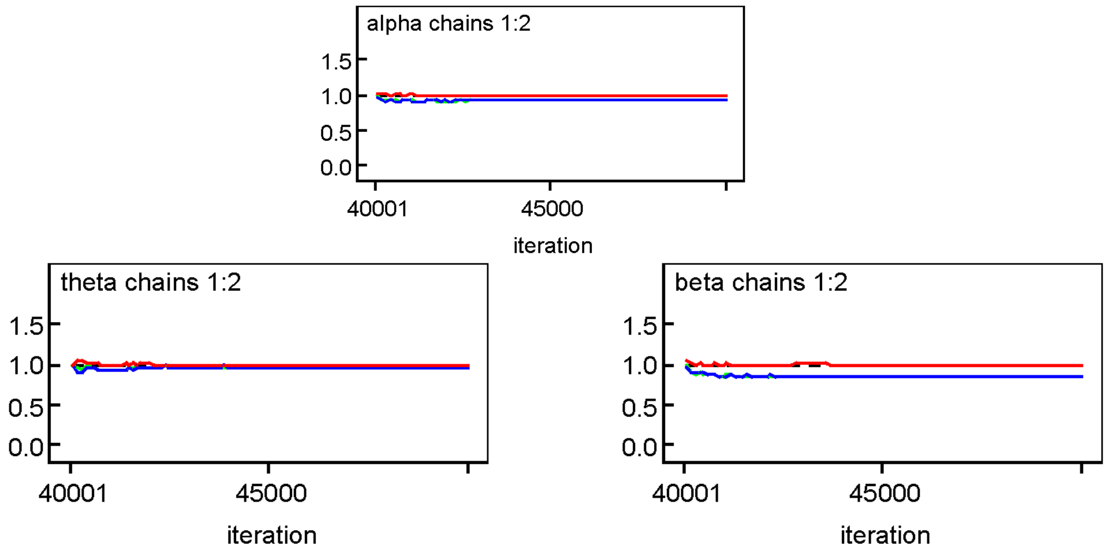
To obtain inference, the analyst samples from values from the posterior distributions via simulation techniques such as MCMC. The first step is to ensure that the simulated chain or chains are stationary. Although it is theoretically impossible to be 100% sure that the chain has converged, a series of 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 to some part of the distribution but fails to cover its proper range, then these plots indicate a high degree of autocorrelation for large lags. Here, it is obvious that there is no such problem. Gelman and Rubin (1992) statistics is used for verifying stationarity, as generalised 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 method of inspection of whether the simulated chain has converged is to look at the multiple chain trace plots for the monitored nodes. 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.

Figure 2 Convergence tools for reaching stationarity of MCMC

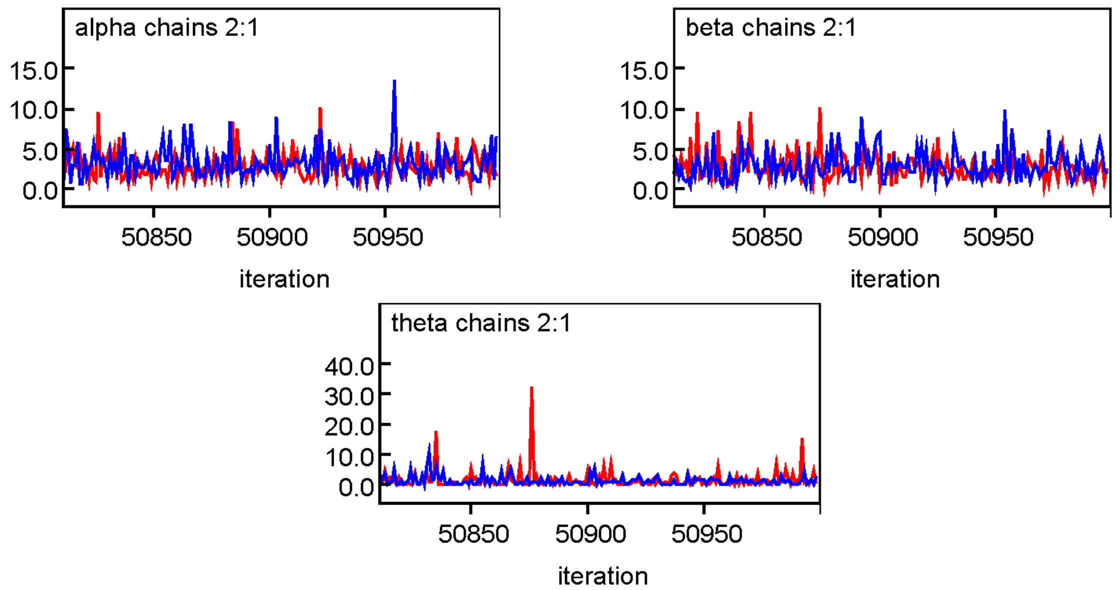




(a)



(b)



(c)

The results reported below for the models we use were obtained after a burn-in period of 40,000 iterations[5]. To determine whether our data reflects a time trend, we use a model called Poisson with Time Trend (PTT) in the arrival rate:

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

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 parameterisation 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

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

For forecasting purposes, we use two non-standard models described by Scollnik (2001).

The first employs the Zero-Inflated Poisson (ZIP) distribution given by

$$
\Pr(X = x \mid \lambda, \mu) = \begin{cases} \lambda + (1-\lambda)\mathrm{e}^{-\mu}, & x = 0 \\ (1-\lambda)\dfrac{\mu^x \mathrm{e}^{-\mu}}{x!}, & x = 1, 2, 3, \ldots \end{cases} \tag{7}
$$

with $0 < \lambda < 1$ and $\mu > 0$.

The second is based on the Generalised Poisson (GP) distribution as proposed by Consul (1989) and is described by

$$
\Pr(X = x \mid \lambda, \mu) = \frac{\mu(\mu + \lambda x)^{x-1}}{x!} \mathrm{e}^{-(\mu + \lambda x)}, \quad x = 0, 1, 2, \ldots \tag{8}
$$

with $0 < \lambda < 1$ and $\mu > 0$.

These models can be used to estimate the probability that in the future there will be 0 events, 1 event, 2 events and so on. Here, the probability of seeing a large number of events, although non-zero mathematically is zero. That is, the probability mass distribution function produced by these models has smaller and smaller probabilities in the right tail. Therefore, one may decide to consider only a sufficient number of probabilities. In the next section, only the first eight probabilities are reported.

However, from a methodological point of view, there is no problem in estimating more probabilities if needed.

4 Empirical results

4.1 The MCMC

The beauty 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.

As might be expected, the level of political risk in Pakistan is very high with an average of nearly 1.5 events per year. 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)[6].

Table 4 Posterior estimation for the Poisson-Gamma model

Node	*Mean*	*Sd*	*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

The next question we ask is whether there is any time trend in the arrival of political events that impact on 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 shows that the 95% credibility interval[7] for the coefficient *b* contains zero, and thus we may conclude that this coefficient is not significant. Therefore, there seemsto be no time trend in the arrival rate of political events in Pakistan. This means that although it has been relatively high, political risk has also been relatively stable over the period. Given the turbulent international economic and political situation starting from 1994 with the 'Tequila Crisis' and ending with 11 September 2001, this result might be better than it seems.

We now turn to the ZIP and GP models to estimate the probability of 1, 2,...,8 events.

The Bayesian inference for ZIP and GP models are summarised in Tables 6 and 7, respectively. The probabilities *p*[1], …, *p*[8] define the probabilities to see the arrival of 0, 1, 2,…, 7 events, respectively. The slight change of correspondence was necessary to conform to the software programming requirements. The truncation at 8 is done on an ad hoc basis here, but the same methodology can be applied for more or less events. As emphasised in the previous section, MCMC techniques are a very powerful inferential engine. In fact, the analyst can see the whole posterior distribution of all parameters of the models. This is helpful here because, by looking at the posterior distributions of parameters *p*[1],…, *p*[8] as shown in Appendix Figures A1–A4, it can be seen that the distributions of higher-order probabilities such as *p*[7] and *p*[8] are very much skewed and clustered around their almost zero mean value.

Table 5 Posterior estimation for the Poisson model with time trend in arrival rate

Node	Mean	Sd	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

Table 6 Posterior estimation for the Zero-Inflated Poisson model

Node	Mean	Sd	2.5%	Median	97.5%
lambda	0.4247	0.101	0.2065	0.4310	0.6035
mu	1.505	0.2969	0.9670	1.4870	2.1250
p[1]	0.5615	0.0650	0.4338	0.5627	0.6854
p[2]	0.1909	0.0447	0.1132	0.1877	0.2859
p[3]	0.1386	0.0211	0.0986	0.1383	0.1801
p[4]	0.0697	0.0176	0.0371	0.0691	0.1055
p[5]	0.0273	0.0114	0.0093	0.0258	0.0531
p[6]	0.0088	0.0053	0.0018	0.0076	0.0221
p[7]	0.0025	0.0020	3.02E-4	0.0019	0.0077
p[8]	7.792E-4	8.933E-4	4.825E-5	4.945E-4	0.0031

Table 7 Posterior estimation for the Generalised Poisson model

Node	Mean	Sd	2.5%	Median	97.5%
lambda	0.2877	0.1131	0.0839	0.2817	0.5260
mu	0.6273	0.1271	0.4024	0.6196	0.8953
p[1]	0.5383	0.0671	0.4085	0.5382	0.6688
p[2]	0.2493	0.0393	0.1742	0.2492	0.3268
p[3]	0.1116	0.0225	0.0716	0.1103	0.1591
p[4]	0.0504	0.0117	0.0296	0.0497	0.0750
p[5]	0.0237	0.0077	0.0099	0.0232	0.0398
p[6]	0.0117	0.0055	0.0029	0.0112	0.0237
p[7]	0.0062	0.0038	7.683E-4	0.0055	0.0152
p[8]	0.0089	0.0102	2.555E-4	0.0056	0.0374

Following Dempster (1997), we use the posterior means of the negative log-likelihood statistics for model selection or comparison. From Table 8, the zero-inflated model seems to be preferred.

Table 8 Comparison of posterior means of the negative of the log-likelihood for three models

Model	PTT	ZIP	GP
Posterior mean	150.376	69.45	71.66

4.2 The risk premium for political risk

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 owing 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. Consider the following notation:

V: Theoretical value of the stock market in the absence of political risk

I: Value of the stock market observed with political risk

v: Value of the hypothetical insurance policy for political risk

R: Required rate of return on the stock market

α: Growth rate of the value of the stock market

r: Risk free rate of interest

α^*: Risk neutral growth rate

δ: Dividend rate on the stock market, which we assume is a policy variable and is known

J: Percentage of the stock market value that is lost when a political event happens.

Clark (1997)

$$V = I + v \qquad (9)$$

And

$$v = \frac{\lambda J I}{\delta} \qquad (10)$$

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

Using the discounted dividend model, the observed stock market value can be written as

$$I = \frac{\delta I}{\delta} \qquad (11)$$

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

Substituting equation (10) and (11) into (9) and rearranging gives

$$(R - \alpha)V = I\,(R + \lambda J - \alpha). \qquad (12)$$

From equation (12), we can see that the risk premium owing to political risk is equal to λJ. Based on the foregoing MCMC results, we know that $\lambda = 1.5$. We estimate J as the average loss owing to the political events cited above and find it is between 5% and 8% of the value of the stock market.[8] Thus, the risk premium owing to political risk λJ is between 7.5% and 12%.

5 Conclusion

In this paper, we have identified the major political events that have influenced Pakistan's stock market since 1947. We have collected 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. Then, we analysed collected data and made forecasts using Bayesian modelling and MCMC techniques, which are well adapted to the field of political risk where events are rare and data is sparse. 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. Forecasts based on the latest data suggest that this situation should continue for the foreseeable future. We find that the risk premium owing to political risk is very large, lying somewhere between 7.5% and 12%.

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Appendix

Figure A1 Posterior densities of parameters of Poisson-Gamma model (see online version for colours)

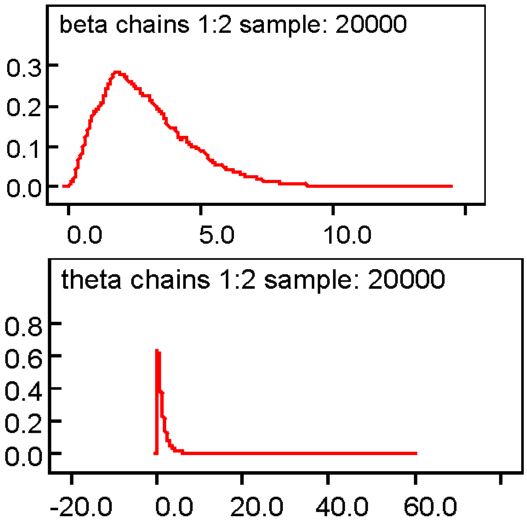


Figure A2 Posterior densities of all parameters of interest for the Poisson model with time trend in the arrival rate (see online version for colours)

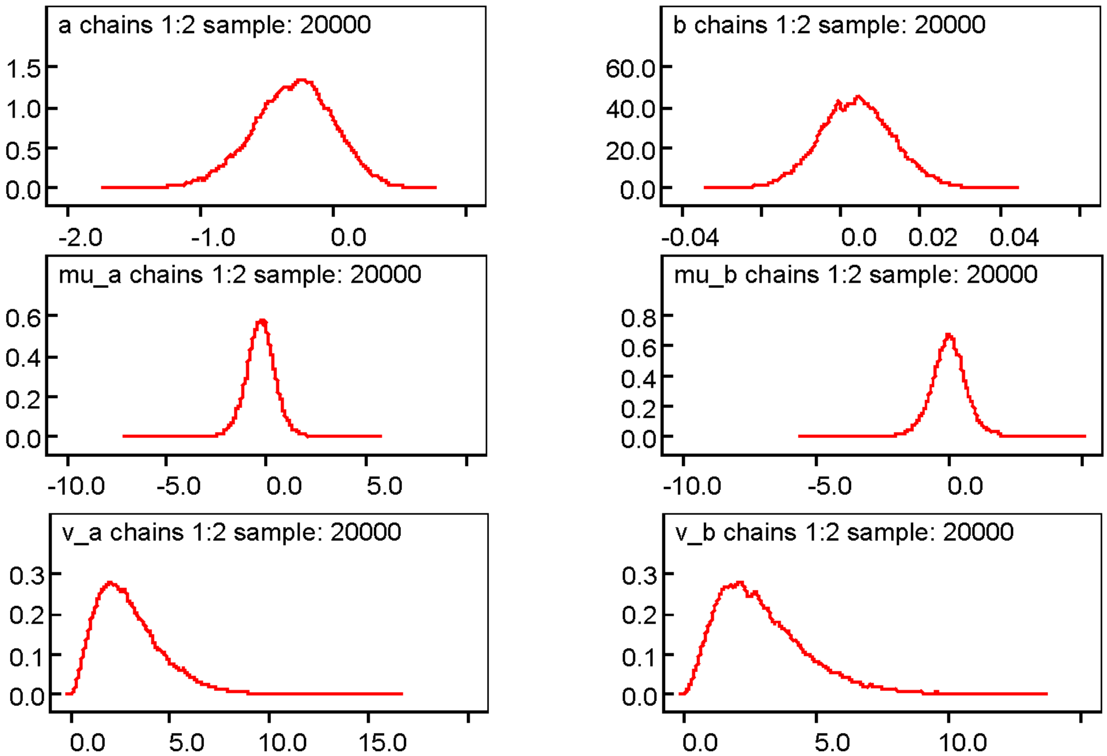


Figure A3 Posterior densities of all parameters of interest for the Zero-Inflated Poisson model (see online version for colours)

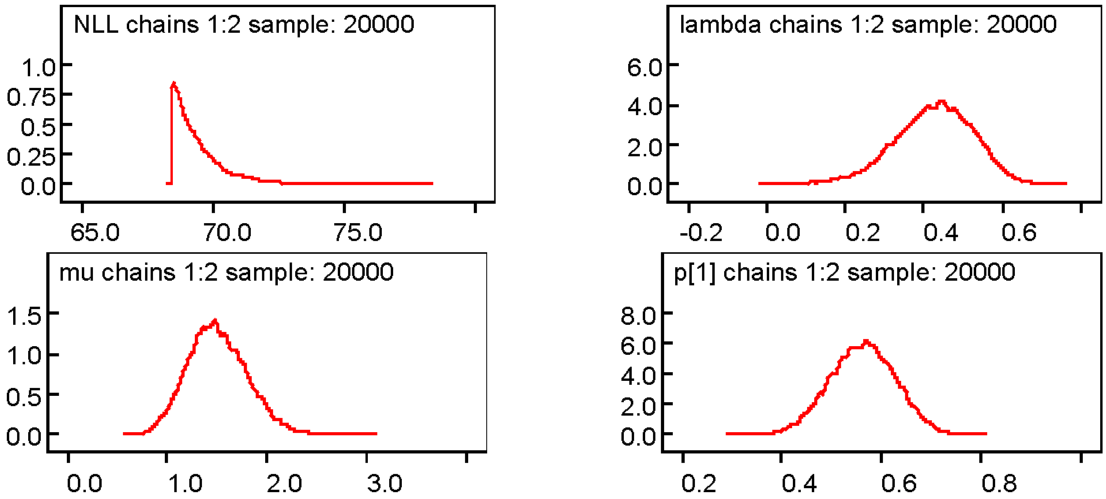


Figure A3 Posterior densities of all parameters of interest for the Zero-Inflated Poisson model (see online version for colours) (continued)

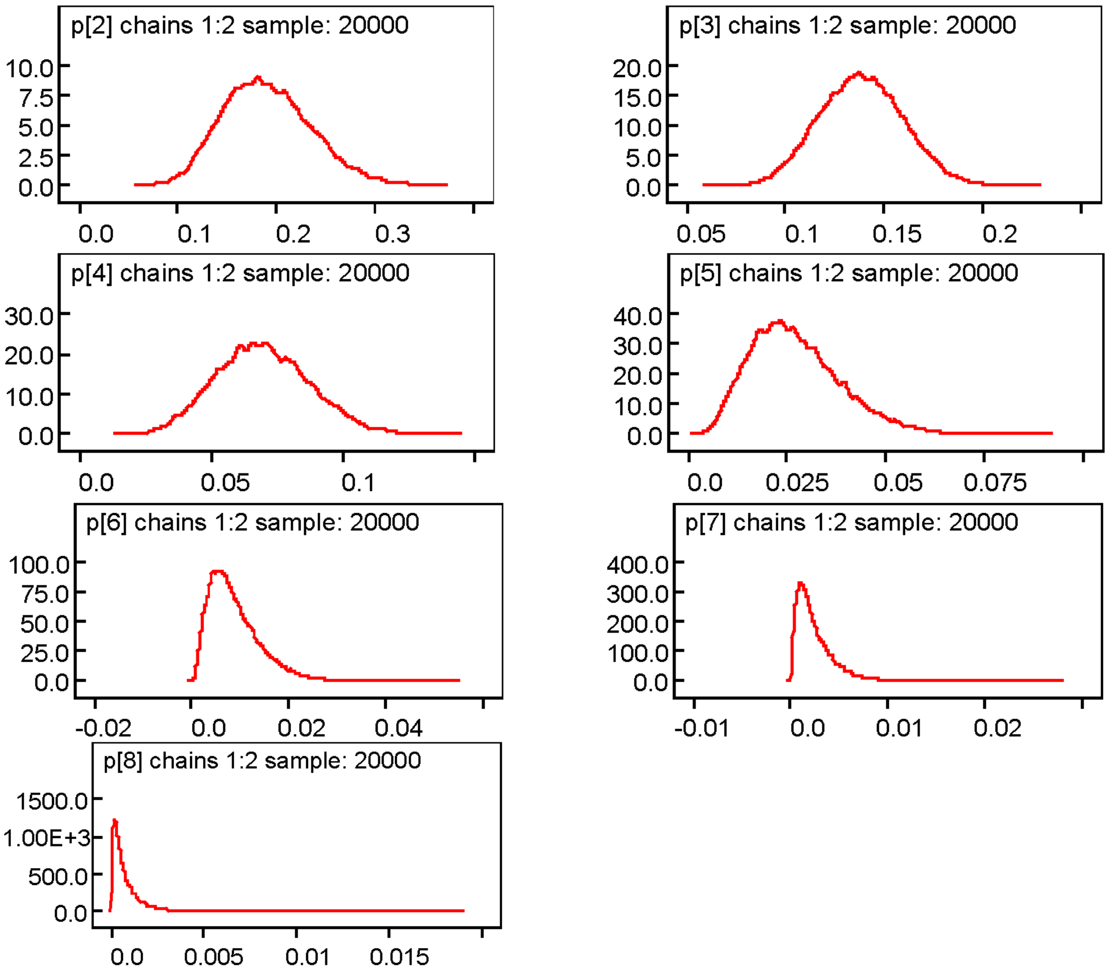


Figure A4 Posterior densities of all parameters of interest for the Generalised Poisson model (see online version for colours)

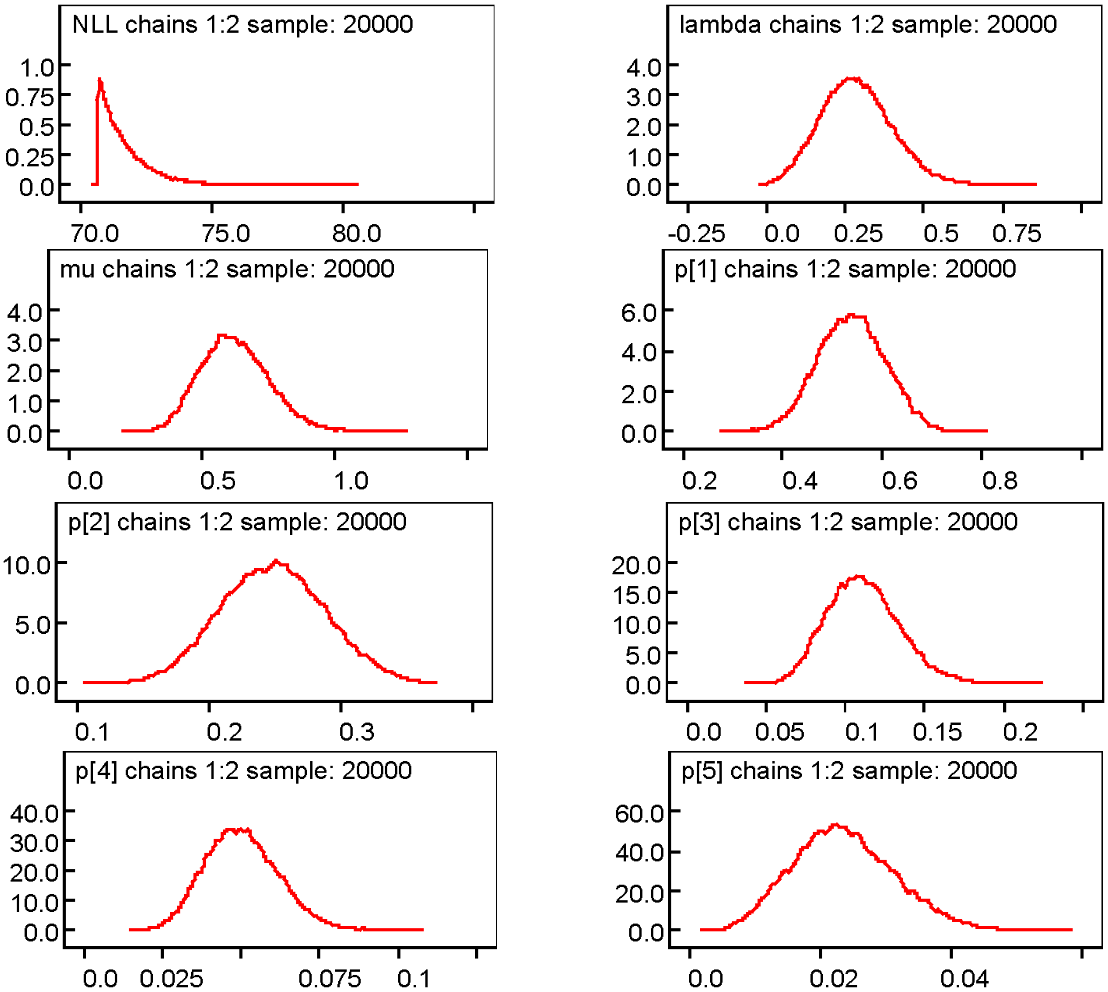
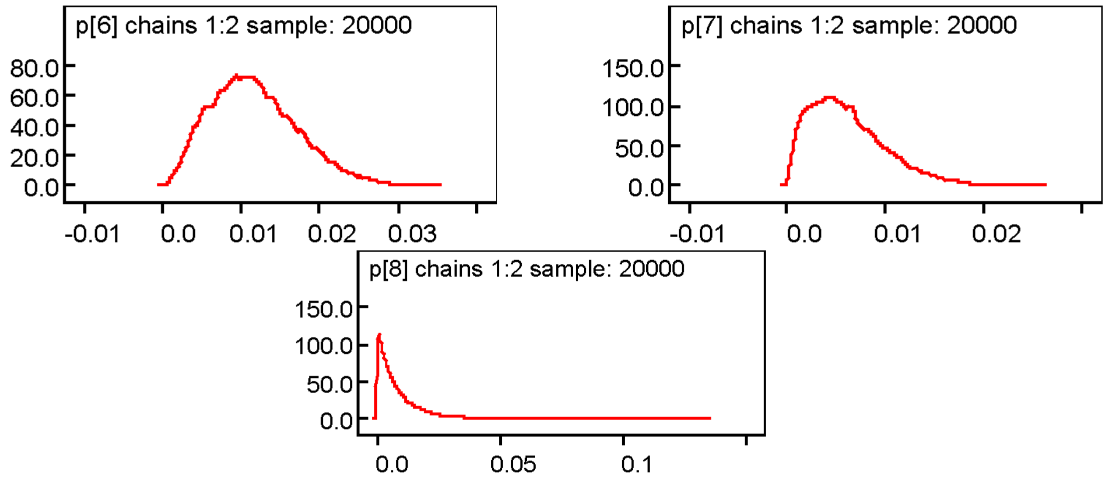


Figure A4 Posterior densities of all parameters of interest for the Generalised Poisson model (see online version for colours) (continued)



Notes

[1] The total number of listed companies in the relevant year have been stated after nine companies delisted in the year 1998, five companies in 1999, five companies in 2000, 12 companies in 2001 and 24 companies in 2002 and five in 2003 and six companies merged in the year 1997, two companies in 1998, three companies in 1999, one company in 2000, seven companies in 2001, 16 companies in 2002, two in 2003 and addition of two companies by splitting/bifurcation in the year 1998 and one company in the year 2001 (see Khan and Lubna, 2001).

[2] Prominent individuals include: Historians, economists, politicians, government officials, investors, senior bankers, stock market analysts and those individuals who play a major role in influencing the Pakistani stock markets.

[3] The detailed questionnaire is presented in the Appendix.

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

[5] 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.

[6] Jump-diffusion models and Levy processes can capture the effects of discrete jumps

[7] The credibility interval is the Bayesian equivalent of the confidence interval in classical econometrics.

[8] The problem is to determine the time around the event over which the loss is measured.