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Benesova, Hana

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The Theory of Earthquakes in Signalling Severe Political Events

H. Benesova[1]

[1]University of Huddersfield, Huddersfield, United Kingdom. E-mail: h.benesova@hud.ac.uk

ABSTRACT: This research seeks to conceptualise the use of an earthquake forecasting theory to signal severe political risks such *as wars, coups d'état, demonstrations and revolutions. The justification for linking the theoretical framework o*f an earthquake with severe political risks is twofold. Firstly, it is generally random in its nature; however, there are some patterns which can help in predicting the occurrence of future earthquakes. Secondly, an earthquake is usually region-specific, i.e. there are geographical regions which are prone to earthquakes more than other locations, and there are regions where the odds of an earthquake occurrence are minimal; however, under certain circumstances there is always a negligible possibility of such an event occurring. Severe political events are similar in their nature as they are also location-specific and random in their occurrence. In order to establish the link between these two phenomena, a clearer definition of these two variables will need to be established. Thus this theoretical research will first define the nature of severe political risks in globalised world followed by definition of an earthquake and its nature. Once a clear definition of these two variables has been established, the discussion will move towards discussion of various models for signalling severe political risks and earthquakes. It will conclude by suggesting a new approach to signalling the possibility of an occurrence of severe political events based on various assessment models and methods employed in forecasting an occurrence of an earthquake.

Keywords: Political risk, severe political events, risk signalling, earthquake theory.

1. INTRODUCTION

Both earthquakes and severe political events such as wars, coups d'état and revolutions are damaging events both for the Earth and for society itself. While earthquakes stem directly from the Earth and their cause lies in Nature, political events stem from society. However, there are common patterns between these two hazards in terms of both their causes and consequences. Therefore the main purpose of this paper is to establish such a link and propose a research framework to allow us to make use of currently established forecasting frameworks for earthquake prediction in signalling severe political events. The term signalling is used intentionally and should not be interchanged with terms prediction and forecast as the purpose is not to predict where and when specifically would an event occur. The purpose of this research is to indicate zones with increasing political and social pressure. In order to do so, this paper will first define the terms earthquake and severe political event which would be followed by a discussion of their nature and the mutual link in patterns characterising each one of these phenomena as well as various assessment techniques for forecasting these events. The discussion will conclude by proposing a model for signalling severe political events based on methods for forecasting earthquakes.

2. EARTHQUAKES AND SEVERE POLITICAL RISKS

2.1 Definition of Phenomena

Before discussing the link between an earthquake and severe political risk (SPR) a clear definition needs to be established for both these phenomena. An earthquake is usually defined as "a sudden release of energy in the earth's crust or upper mantle, usually caused by movements along a fault plane or by volcanic activity and resulting in the generation of seismic waves which can be destructive" (Collins, 2014). The definition of a severe political risk is not as straight forward as that of an earthquake; however in order to make a clearer definition of an SPR for the purpose of this research, it could be defined as an event which has disastrous consequences on society and the environment in which it occurs; examples of such event could be war, revolution or coups d'état. Given that both earthquakes and SPRs are treated as events, a distinction between the terms hazard and risk and their link to potential harm needs to be discussed as well.

By definition, hazard is any source of potential damage, harm or adverse effect on something or someone under certain conditions in the environment of concern (Waring and Glendon, 2001). When quantified and expressed in such manner which is

capable of probabilistic prediction of the harm or damage occurring such hazard becomes a risk (Hofstede, 1997; McLean and McMillan, 2003). However, although a number of signalling variables have been developed in order to forecast both political risk and earthquake risk these do not always allow researchers to provide a precise forecast of neither one of these events. As a result this research treats both SPRs and earthquakes as events, and therefore does not attempt to quantify them in order to convert these hazards into a risk.

2.2 Common Patterns of Earthquakes and SPRs

The nature of an earthquake and a SPR is similar. Both these phenomena are caused by activity and unexpected movements causing pressure which as a result needs to be released in form of an upheaval varying in its magnitude; moreover as pointed out by McKenzie and Jackson (2012) an earthquake can sometimes trigger a wave (tsunami) which influences environments more distant from the main epicentre which, given recent experience with the "Arab Spring" is also applicable to SPRs (Jones, 2012). There are also common patterns which are characteristic for these events; they are generally described as random in their occurrence and location specific. This is also reflected in the reliability of various assessment techniques which is very limited. There have been attempts to produce techniques and models which would make such forecast available in both fields; however the approach differs in each one of them with earthquake forecast relying largely on quantifiable hard data and previous events (Vere-Jones, 1995) and SPR forecast combining quantitative approach with more 'soft skill' expert opinion (Kobrin, 1979; Al Khattab et al., 2008). Before discussing these forecasting models in more detail the following table needs to be presented in order to provide a clearer overview of similarities and/or differences between earthquakes and SPRs.

Table 1: Overview of Characteristics of Earthquakes and SPRs

PR	Characteristics of Event	EQR
Yes	Strong events are linked to small events	Yes
Yes	Likelihood of occurrence is region specific with rare variations	Yes
Limited	Possibility of forecast based on past experience	Limited
Limited	Unexpected occurrence of events	Yes
Yes	Differences in magnitude and harm caused	Yes
Societal	Result of previous pressure	Natural
Yes	Extent of harm depending on magnitude of event	Yes
Yes	Signaling variables are available	Yes
Limited	Reliability of precursors	No
Yes	Event can be divided between micro and macro scale	Yes

3. FORECASTING OF SPRS AND EARTHQUAKES

There are various methods for forecasting both earthquakes and political risks. However, since the assessment techniques for political risk forecasting do not focus on severe events in particular, a forecasting technique from the field of earthquakes can be applied to the field of political risk which would enable us to forecast these SPRs. In order to generate such a model various precursors and assessment techniques will need to be discussed. A combination of pattern informatics model and Guttenberg-Richter frequency-magnitude scaling has been chosen for application in signalling severe political events. The reason why this research aims to make use of this method is that it respects the very nature of its phenomena and is also aware of its limitations and limitations in forecasting in general, which in the remaining forecasting techniques are not always acknowledged to its full extent (Holliday, 2005; Sachs et al., 2012). As a result of this method, this research should be able to identify potential locations which are more prone to SPRs based on various precursors which were extrapolated from literature aimed at political risk.

3.1 Forecasting Models

There are various methods for forecasting both earthquakes and political risks. As already mentioned, these vary mainly in method with earthquake forecasts relying largely on quantitative methods (Vere-Jones, 1995; Kagan and Jackson, 2000; Rhoades et al., 2011) whereas political risks forecasts make use of both quantitative and qualitative methods (Kobrin et al., 1980; Kobrin 1982; De Mortanges and Allers, 1996; Al Khattab et al. 2008). However given that political risks are treated mostly as a set of various micro and/or macro risks rather than separate events a model for signalling SPRs has not been established yet. However, given the similarity of SPRs and earthquakes, some approaches to earthquake forecasting can be applied to signalling SPRs. The

following sections will discuss the general role, validity and reliability of precursors in forecasting followed by the proposed research concept.

3.2 Precursors

In earthquake forecasting, precursors are an important factor which is similar for the majority of earthquakes. These could be for example changes in seismicity, seismic velocities, electromagnetic signals, or change in animal behaviour. However, as Sachs et al. (2012) noted there is generally an absence of time-admissible precursors of earthquakes. There is an issue with identifying precursors for SPRs as the nature varies significantly according to their causation. In general an SPR can stem from various issues in society, such as government instability, culture or social related issues or economic instability (Leebaert and Howard, 1983; Collier and Hoeffler, 1998; Ohlson, 2008; Midtgaard et al., 2014) however all are related to political situation and although not always triggered by political institutions themselves, these are usually initiated by some conflict arising from them. However, given that the precursors for earthquake forecasting have not proven themselves to be particularly reliable (Vere-Jones, 1995; Holliday et al., 2005), the omission of such precursors in SPRs forecasting will not produce bias in the forecast and therefore a framework for signalling SPRs can be produced based on the earthquake forecasting model.

3.3 Proposed Research Concept and Methodology

Models and techniques for forecasting earthquakes are numerous, ranging from binary predictions to qualitative methods (Vere-Jones, 1995; Satriano et al., 2011; Sachs et al., 2012). Some of the techniques used for forecasting earthquakes are widely used by researchers in political and social sciences as well, usually accompanied by expert opinions and qualitative approach in order to produce final forecast (Kobrin et al., 1980). Since SPRs are usually included in the analysis with smaller-scale events of political nature, these are usually treated equally; however their scale and therefore their impacts are far more severe than that of smaller political conflicts. Therefore we propose the following model to be used in order to signal an SPR.

Having considered the similarities of and distinctions between the two phenomena, we propose the method used for signalling SPRs to be the Pattern Informatics (PI) model in combination with Guttenberg-Richter frequency-magnitude scaling. PI model divides map into windows for which binary forecasts of an earthquake occurrence are then determined (Bowman et al., 1998; Holliday et al., 2005; Toya et al., 2010) which would allow us to determine hotspots for possible conflict arising. Once these hotspots will have been established the Guttenberg-Richter frequency-magnitude scaling will be applied to events in these hotspots which would allow us to identify increasing 'social-political seismicity' in hotspot areas (Roy and Mondal, 2012; Sachs et al., 2012). Therefore a map with smaller political events which could be treated as smaller earthquakes to be produced with increasing intensity and magnitude in decreasing intervals of occurrence would signify increasing pressure in the society where as a result an SPR event type would be threatening the society as the map would signal a hotspot, i.e. a region with increasing "social seismicity" which might result in an event of "greater magnitude". In order to be able to signal SPRs, measures for magnitude of smaller events will need to be established. In order to establish the value of all magnitudes, intensity and intervals of the occurrence of conflicts a measure will need to be established which would signal an increasing threat of an SPR arising.

In order to establish the measure for magnitude, intensity and intervals a PRS Group database of political risks will be used (PRS Group, 2014). This would allow us to predict values at which a region is becoming a "hot spot" area and therefore an SPR is becoming a real threat. Once these values have been determined based on past experience, a map of political events would be established, making use of algorithms and software already established for prediction of earthquakes.

3.4 Research Limitations and Contribution

There are however some limitations, such as it does not always mean that an SPR will occur in regions with an increased social pressure as there is a human power over these situations where opposing parties can agree to a dialogue and eventually find a compromise; however it is still useful to track the situation as these pressures then increase potential risk for traders and by extension society. Another limitation is the changing nature of political environment, i.e. the measures for magnitude, intervals and intensity will need to be updated regularly; however, this dilemma could be solved by an algorithm used for option pricing, therefore the signalling values will be constantly updated. One of the limitations however is rather societal and there is a lesson to be learned from earthquake forecasting as well. There have been numerous occasions on which an earthquake was predicted which did caused panic in the region, however it turned out to be a false alarm. Nevertheless we believe that if used with respect and carefully, such assessment could provide information for various institutions dealing with conflicts and traders in international business arena.

4. ADDED VALUE FOR THE POST 2015 FRAMEWORK FOR DISASTER RISK REDUCTION

The main value of this research for the reduction of risk disaster lies in the demonstration of a link between natural disasters and societal actions which is still generally omitted in research. The importance of the inclusion of natural hazards in the social sciences has a value embedded in the mutual interconnectedness of human to its entire environment, and therefore the applicability of lessons from Nature to social behaviour. The effect of both natural disasters as well as disasters stemming from societal actions and influences have negative effects on the society and quality of lives and therefore it is necessary to study the link between these two areas. It is necessary to apply the lessons learned from natural disasters as these are in most cases a direct result of human action (or inaction) and by extension these influence the society as a negative result of its actions. Due to its connectedness some of the techniques which are used for prediction of natural disasters and lessons from dealing with natural disasters should be used in explaining the nature of severe human actions in certain regions which have a disastrous impact on the given region but also, given various patterns of globalization, the world at large.

5. CONCLUSIONS

There are some obvious commonalities between severe political events and earthquakes both in their nature and their causation. The purpose of this paper was to establish this link which allowed us to identify theories for forecasting earthquakes which could then be applied to severe political events and identify an emerging SPR. Since this is a theoretical paper proposing new methodology, we have not been able to verify the usability of our model; however, once the model has been fully developed it would then be suitable for a case study research where it would be tested, and further developed on basis of these results.

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