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Predicting Social Tipping Points

Current research and the way forward

Sonja Grimm
Gerald Schneider

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Foreword

This paper has been produced under the umbrella of the DIE research project “Development Policy: Questions for the Future,” for which funding from the German Ministry for Economic Cooperation and Development (BMZ) is gratefully acknowledged. One component of this project has been to assess research methods that can be applied to help anticipate changes in the environment that development policy is designed to respond to. In an early stage of this project, studies written by Kosow / Gaßner (DIE Studies 39) and Lundsgaarde (DIE Studies 40) examined this general issue with reference to methods of futures and scenario analysis. In this discussion paper, Sonja Grimm and Gerald Schneider assess methods in the social sciences that can be used to predict social tipping points, characterised as abrupt shifts in social systems. They argue that the comparative utility of alternative approaches to prediction depends on factors such as the nature of data availability, the geographical scale of the analysis, and the forecasting time horizon. Apart from offering guidance on when these approaches to prediction are most relevant, the authors use this analysis to point to ways that early warning can be improved in development policy planning. Beyond methodological considerations, they note that a key part of the challenge of improving early warning relates to how social scientific analysis can be better embedded in the policy setting, suggesting a need for continued reflection on institutional innovations to strengthen the linkage between research and policy choices.

Erik Lundsgaarde

Bonn, April 2011

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Abbreviations

ADA	Austrian Development Agency
BMZ	German Ministry for Economic Cooperation and Development / <i>Bundesministerium für wirtschaftliche Zusammenarbeit und Entwicklung</i>
BVAR	Bayesian vector autoregression
CIDA	Canadian International Development Agency
CPIA	Country Policy and Institutional Assessment
EAWARN	Network for Ethnological Monitoring and Early Warning
EU	European Union
FAST	Early Recognition and Analysis of Tensions
FEWER	Forum on Early Warning and Early Response
FYRM	Former Yugoslav Republic of Macedonia
GDP	Gross Domestic Product
ICEWS	Integrated Crisis Early Warning System
ICG	International Crisis Group
INCAF	International Network on Conflict and Fragility
KEDS	Kansas Event Data System
LICUS	Low-Income Countries Under Stress
MS-BVAR	Markov-switching Bayesian vector autoregression
NATO	North Atlantic Treaty Organization
ODA	Official Development Assistance
OECD	Organization for Economic Co-operation and Development
OSCE	Organization for Security and Co-operation in Europe
SDC	Swiss Agency for Development and Cooperation
SIDA	Swedish International Development Cooperation Agency
WANEP	West Africa Network for Peacebuilding
WBGU	Wissenschaftlicher Beirat der Bundesregierung Globale Umweltveränderungen

Executive Summary

The prediction of the breakdown of social order is both a considerable academic challenge and a major development concern. This essay argues that recent advances in the social sciences enable the policy community to meet these challenges. Against recurrent scepticism, we argue that the prediction of political stability is a must and that the three main approaches used to assess these risks – the *structural*, the *dynamic* and the *game-theoretic* approaches – supplement each other in the task of predicting such extreme events like state failure. Our analysis particularly points out that:

- the *structural approach* can be used for global risk assessments in which the risk to a country of experiencing a social tipping point is clearly identified;
- the *dynamic approach*, which is used in various time series designs, may help the research and development communities to identify possible phase shifts in which social interactions risk severe deterioration; and
- the *game-theoretic approach* is able to predict some of the more irregular events and that some of the findings from the other approaches can be used for the implementation of this rather static approach.

Although these approaches – alone or in conjunction with each other – can help us to identify some real risks, one of the key problems is the translation of these findings into reasonable policy recommendations and the creation of a culture where policy makers evaluate their priors based on systematic input from the social sciences. One particular challenge that the academic world and practitioners have to address is the forecasted effectiveness of various policies that aim at reducing the risk of social and political instability.

While there are an increasing number of sophisticated forecasts of social failure that do not take varying policies into account, the real usefulness of forecasting is the evaluation of how various political instruments are able to address the challenge of social tipping points. The next generation of forecasting models will undoubtedly also need to address how varying policy choices are able to reach their goals *ex ante*. This presupposes, however, a willingness in the policy circles to use such evaluation instruments.

1 Introduction

The purpose of this study is twofold: first, to offer a conceptual foundation for explaining and predicting *social tipping points* considering three social science methods for the analysis of crucial bargaining situations, and second, to propose a formal model rooted in rational choice theory for explaining and predicting *social tipping points*. With *social tipping points* we mean constellations where the social fabric of a country breaks apart and where a country embarks on a course of dramatic, but not always violent political change. Usually, complex systems are assumed to respond to gradual change in a smooth way. However, most of them also have critical thresholds – “*tipping points*” – “*at which the system shifts abruptly from one state to another*” (Scheffer et al. 2009, 53). This definition matches a standard dictionary definition of a tipping point, where the concept represents a constellation “*at which a series of small changes or incidents becomes significant enough to cause a larger, more important change.*”¹

The concept of tipping points has played an important role in the social and natural sciences since Grodzins (1958) coined the term and Schelling (1971, 1972) formalized it. The 1971 article by Schelling was cited in the Web of Knowledge until December 2010 by 500 articles from a wide variety of disciplines, ranging from economics to mathematical physics to environmental affairs. Beyond the often metaphorical usage of the term “tipping point”, however, there is relatively little systematic research that conceptualizes the societal conditions under which a society suddenly moves from one predominant behavioural pattern to another one or, to put it into the parlance of game theory, from one equilibrium to the next one.

Radical change is present in almost all social and biological systems. Global financial markets for example encounter sudden systemic market crashes like the “Black Friday” event in 1929 or the 2008 global financial crisis which fundamentally altered the interactions among economic agents for years to come and which, at least in the former case, also heralded catastrophic developments in the political sphere. In ecosystems radical change can manifest itself for instance in the rapid loss of transparency and vegetation observed in shallow lakes, in the swift overgrowth of fleshy brown algae in Caribbean reefs, or, at a slower pace, in the irreversible desertification processes in the Sahara region. On the eve of such events, complex systems might lose their resilience to deal with external and internal shocks and the capacity to maintain their original states (Scheffer et al. 2001, 592–593).

Like economic and ecological systems that experience sudden shifts, social systems can also encounter tipping points. The explanation and prediction of *social* tipping points enjoys a rich tradition in the social sciences. The field of research encompasses the study of social revolutions and regime changes, examinations of how economic or environmental shocks affect the risk of violent conflict as well as analyses of what was called “state failure” and is now more conventionally termed “state fragility” or “state instability”. In this study, we survey the literature on how the social order in fragile societies breaks down, and what factors key contributions to this field believe to be responsible for such radical changes. To this end, we review and discuss the literature that tries to explain and predict

1 See online: http://english.oxforddictionaries.com/search?q_0=tipping%20point&f_0=full_text (accessed 10 December, 2010).

such social tipping points. We therefore restrict the analysis to a review of recent attempts to scientifically predict breakdowns in the political and social order and some of its most extreme manifestations, including crashes of economic and financial institutions, authoritarian and democratic regime change, internal war, domestic terrorism and genocide. We differentiate between endogenous and exogenous tipping processes and contend that attempts to forecast radical change have to be aware of several problems prediction faces in the natural and social sciences. We discuss some of these problems and discuss which forecasting approach will be appropriate for which sort of tipping process. Our categorization attempts are discussed in light of recent attempts in the social sciences to forecast instability and conflict (e. g. Beck / King / Zeng 2000; Rost / Schneider / Kleibl 2009; Ward / Greenhill / Bakke 2010) which have led to several attempts to assess the predictive accuracy of competing models (e. g. Thomson et al. 2006; Schneider / Finke / Bailer 2010a; O'Brien 2010).

1.1 The concept of “tipping points” in the natural sciences

Each of us is used to dealing with at least one method of more or less accurate prediction in everyday life: the weather forecast. Meteorologists have improved their tools for forecasting in the last decades significantly (Malberg 2002). They perform weather predictions routinely every day and for varying time horizons. Over the past few years, the time span for these forecasts has been extended considerably and the geographic differentiation has increased. Weather forecasts contain valuable information for farmers interested in effective agricultural production, but they also alert the public to extreme weather events like typhoons, hurricanes, and heavy rain or snowfall. The search for the conditions under which such dramatic events unfold is paralleled by the attempts to understand and predict long-term climate change.

In the current discourse on the increasingly fragile earth climate, the tipping point concept has gained a particularly prominent role. In a popular notion, it describes the moment in time when human activities have such large-scale impact on components of the earth system that these components pass into qualitatively different modes of operation what in turn has large-scale impact on human and ecological systems. Typical examples in the public debate are the dieback of the Amazon rainforest or the decay of the Greenland ice sheet.

In a systematic way, Lenton et al. focus on subsystems of the earth system and define the *tipping point* as the “*critical point ... at which the future state of the [at least subcontinental] system is qualitatively altered [by small perturbations]*” (2008, 1786). Lenton et al. include nonclimatic variables for explaining and predicting tipping points, namely human activity to cause large-scale changes and public awareness of such changes (2008, 1787). Furthermore, they are aware of slower cases of transition where one tipping point may not be obvious but the change will have nevertheless a critical impact on the system in the future; and they leave open whether the transition is reversible or irreversible.

In an interdisciplinary endeavour, natural and social scientists from various disciplines refer to “tipping points” as strongly non-linear, extreme responses by components in the climate system (WBGU 2008). Unlike Lenton et al. (2008), the WBGU experts perceive these substantial changes as most often of a qualitative nature, suggesting that such

changes increase the risk that the system *irreversibly* crosses a critical threshold by triggering runaway changes that are very difficult to bring under control again (WBGU 2008, 72). They also cite the Greenland ice sheet, which could potentially start to slide and disintegrate if warming exceeds a critical threshold, and the Amazon rainforest, which could irrevocably die back if a critical point of global warming is crossed (WBGU 2008, 73). In other words, the tipping processes, which the world climate has reached or is about to reach, invoke radical change that has far-reaching consequences for human life and societies. The WBGU analysts suppose that for example the collapse of the Amazon rainforest could fundamentally alter agricultural production in Latin America, incurring incalculable economic costs and triggering large-scale migration (WBGU 2008, 72–75). Such extreme changes can, as some fear, even cause violent conflict and war (Burke et al. 2009, but see also Buhaug 2010).

The tipping points identified by these recent advances in climate change research are, in other words, associated with large-scale and complex risks of social, economic and political nature that affect not only single countries, but due to spill-over effects entire regions of the world.

1.2 Value of the concept for the social sciences

As shown above, the tipping point concept has been employed in recent years mainly in the natural sciences to identify the possibility of abrupt changes in earth systems and to develop early warning mechanisms that provide timely warnings for such sudden shifts, although it has its origins in the social sciences. The re-introduction of the concept to social scientific research raises several questions that this study tries to answer. A first challenge that we address is whether tipping point models can be fruitfully used in attempts to avert catastrophic *social* crises. This question is linked to a second query of whether or not the social sciences provide adequate theories and predictive tools for the identification of the critical moments when fragile social conditions risk breaking down. Third, we will examine the relevance of the tipping point concept for development cooperation, emphasising how approaches to studying tipping points can inform early warning initiatives. In other words, this study is designed to present an analysis of how social and political “tipping points” can be studied and how methods for analysing tipping points can be applied in a development planning context to anticipate moments of rapid destabilisation in fragile states.

Accurate predictions of the risk of political and social tipping can enable the development community to use mediation and conflict prevention and management instruments more efficiently, given that information is effectively processed and transferred into preventive action.² Adequate moderating behaviour based on careful scientific forecasts may even prevent the escalation of violence to a protracted civil war or to massive forms of one-sided violence such as genocides. For example, the well-timed deployment of the NATO

2 We are fully aware of the problems related to information processing and decision-making that may render it difficult to transfer information about impending crises into preventive action. Even when there is a robust evidence base using appropriate methods to diagnose social tipping points, politicians may shy away from adequate preventive action, and the results of social science forecasting remain unused. However, the flaws of political decision-making and action-taking are beyond the scope of this study.

mission “Essential Harvest” with approximately 3500 troops to the Former Yugoslav Republic of Macedonia (FYRM) in August 2001 with the mandate to disarm ethnic Albanian groups and destroy their weapons combined with the parallel diplomatic missions of the UN, NATO and the EU and negotiations between the conflict parties prevented a civil war between the various parties in the territory according to regional experts. A cease-fire was respected that guaranteed the integrity of the FYRM as a state and its transition to a stable democracy (Lund 2005; Gromes 2009; OECD 2009, 50).

In many cases, however, due to competing political, diplomatic, or economic reasons or due to the lack of political will, for example, international intervention comes too late or is so weak that it cannot prevent the unfolding disaster. Such failures often lead to ex-post facto expressions of consternation that a traumatizing event could have been prevented as it was allegedly easily predictable. Feil for instance mentions that the informational basis would have been sufficient to predict even horrendous developments like the Rwandan genocide in 1994: “... a modern force of 5,000 troops, drawn primarily from one country and sent to Rwanda sometime between April 7 and 21, 1994, could have significantly altered the outcome of the conflict” (Feil 1998, 3).

The case of Macedonia demonstrates the value of robust prediction followed by an adequate international reaction: with a relatively small military mission sent in time, the devastating consequences of a war could be avoided and the potential costs of long-term military engagement and humanitarian assistance that would have been necessary if the civil war had broken out could be limited considerably. The Rwandan case, in our view, illustrates the opposite: the absence of an adequate international reaction led to a devastating escalation of violence although the risk of genocide in this country had loomed large for several years. Systematic research is, in other words, valuable for further advancing social science models, theories, and approaches for the sake of robust predictions on various time scales forecasting the potential collapse of societies and states. Predictions based on social scientific research will deepen our understanding of conflict escalation and its consequences for the survival or breakdown of political systems, thereby allowing the development of adequate tools for preventive behaviour and moderation of conflicts.

But is it possible to predict extreme social events? The recent publication of the best-selling “The Black Swan: The Impact of The Highly Improbable” by Nassim N. Taleb (2007) has reanimated the old debate on whether prediction is useful (Schneider / Finke / Bailer 2010a; Schneider / Gleditsch / Carey 2011 for references). Especially sea-changing events like the fall of the Iron Curtain in 1989/90 or the 2011 upheavals in the Arab world have fostered the view that prediction is difficult and the scientific forecasting of rare, disruptive events close to impossible (see also Lobe 2011 for such a premature interpretation).³ According to Taleb, all important events in history, economy, and politics appear without warning. After-the-fact genealogy (as opposed to forecasting) only gives the *impression* that it explains anything; even worse, such ex-post facto explanations tend to oversimplify complex events. In essence, Taleb argues that nobody precisely anticipated the advent of the most recent revolutionary events because they are so unusual and therefore escape in Taleb’s view any notion of predictability.

3 Note that concerns over the possibility to forecast extreme events are also present in disciplines such as seismology (e. g. Hough 2010). But in these other disciplines we almost never encounter the opinion that such prediction exercises are completely impossible.

We disagree with this pessimistic assessment. Although prediction is no panacea and forecasting particularly disruptive events is a considerable challenge, the social sciences have developed a plethora of approaches that can be used for the precise prediction of social developments. The wide range of approaches might seem bewildering for some. It is, in our view, however, easily possible to sort out scientific from non-scientific forecasts by applying standard measures of forecasting accuracy as the ones discussed in O'Brien (2010).

In the social sciences and elsewhere, forecasting boils down to the evaluation of different scenarios that one can obtain from running competing models. Such model evaluations have to address the same objective, but differ in the general forecasting approach or with regard to the number of explanatory factors. Thomson et al. (2006) and Schneider / Finke / Bailer (2010a) employ various game-theoretic models to assess their forecasting accuracy across a wide set of decision-making cases in EU legislation. O'Brien (2010) presents the results from recent attempts by the US military to develop an Integrated Crisis Early Warning System (ICEWS). Within this program, several top academic forecasters were asked to predict the risk of various correlates of internal instability. Based on these results, O'Brien contends that agent-based simulation models are often an appropriate tool to forecast conflict.⁴

The general academic goal of any prediction is the identification of the model that offers the most accurate forecast in comparison to the real outcome. Politicians and civil servants, by contrast, are mainly interested in real-time forecasts and thus predictions of an event or a trend that is truly unknown. This creates occasional tensions between the forecasters and the practitioners which Wildavsky (1979), using a long-standing Quaker aspiration, summarised in the title to his "Speaking Truth to Power" monograph. These tensions can only be abated if academics ultimately accept that prediction belongs as much to their routine work as explanations; politicians and civil servants should learn that they can only anticipate an outcome of a political process (and possibly counteract it) if the early-warning mechanism on which the forecast relies is scientifically successful.

1.3 Forecasting "True Positives" and "True Negatives"

The general goal of scientific prediction is to have as many accurate forecasts as possible. If the event to be predicted is binary as it is in the case of the occurrence of state breakdown or non-occurrence of this event, we can distinguish "True Positives" and "True Negatives" as the ideal type accurate predictions. A "True Positive", also sometimes labelled "hit", is a correctly predicted event, while the "True Negative" is the correctly predicted non-occurrence of the event of interest. A prediction failure occurs if the forecasting model provides false alarms. These false alarms can be either Type I (prediction of an "event" that in reality did not occur) or Type II errors (prediction that an event would not occur although it occurred). Type 1 errors are also called "False Positives" and Type 2 errors "False Negatives".

4 Agent based modeling studies how social systems evolve based on the interactions of artificial players ("agents").

Several indicators have been introduced to assess the success of a particular forecasting model and to compare competing models systematically. Success here equals model accuracy, recall and precision, meaning how closely the values predicted by the model match with the values observed. The list of criteria to determine model accuracy ranges from the number of point predictions over the mean square error (the residual sum of squares, divided by the number of degrees of freedom) to Theil's (1966) measure of forecasting accuracy, which represents the sum of squared differences between the prediction and the outcome divided by squared deviations of the observed values from a naive prediction. This standard criterion is especially useful in the context of time series predictions (Blieemel 1973). If we can establish clear point predictions, we can also use the criteria discussed by O'Brien (2002, 2010). We would, however, like to add before doing this that no statistic is, in our view, preferable in all applications. According to Achen (2006), models delivering a low mean square error are not unavoidably the ones providing the largest number of correct point predictions.

If we can as indicated above make a binary decision between the occurrence and the non-occurrence of an event, we can establish the accuracy, the recall and the precision of a forecasting model to sort out good approaches from bad ones. The accuracy of a forecast is the number of correct predictions ("True Positives and "True Negatives") divided by the number of predictions made (sum of all Positives and all Negatives) of a particular model. "Recall" measures the number of "True Positives" divided by the number of events that have occurred, and "Precision" assesses the number of "True Positives" divided by the number of events of interest that were predicted to occur.

All these criteria are used for the assessment of the ex-post and the ex-ante accuracy of a forecast. Policy makers are, as outlined above, mainly interested in the latter type of predictions, which are also called "real life forecasts" and thus anticipations of events that have not yet happened. Such "ex-ante" or "out-of-sample" predictions are also of particular interest to researchers as these forecasts prevent that a particular model is only good in identifying cases within the sample of cases under consideration. In other words, real life forecasts help to detect whether a forecasting model is driven by the idiosyncrasies of a particular dataset or not.

A minimal expectation for the accuracy of a model predicting a binary event is that it predicts at least 50 % of all cases correctly and hence that it is at least as good as pure chance. This benchmark is easily achieved if the event of interest is rare and if a model delivers a lot of "True Negative" forecasts. However, the 50 %-benchmark is not sufficient, as a model also needs to deliver "True Positives". Note that quite some prominent contributions have so far failed in delivering this sort of forecast. This is for instance the case for some models of the so-called democratic peace, the Kantian peace approach, which fail to predict any "True Positive" (Ward / Siverson / Cao 2007). Hence, these explanatory models were only able to predict the occurrence of peace between democratic and non-democratic pairs of states, but simultaneously failed to forecast the occurrence of conflict. In other words, standard theoretical model are unable in this setting to identify "True Positives", but do well in predicting "True Negatives". In the case of state fragility, the forecasting ability of prominent models looks a bit better (Goldstone et al. 2010). Applications of prominent contributions to the civil war literature deliver better forecasts as they are also able to forecast events that have really occurred (e. g. Rost / Schneider / Kleibl 2009; Ward / Greenhill / Bakke 2010). However, two theoretical models that have received

widespread attention – the *state capacity approach* by Fearon / Laitin (2003) and the *political economy explanation* favoured by Collier / Hoeffler (2004) – do not perform well in the cross-validation exercise pioneered by Ward / Greenhill / Bakke (2010).⁵

The limited usefulness of influential models in predicting specific dimensions of state fragility alerts us to the necessity to carefully assess the theoretical basis of a model. The predictions do not necessarily need to make much sense theoretically. What ultimately matters is the accuracy of the forecast. Nevertheless, a convincing theory helps us to discriminate between theoretically based and atheoretical prediction models of similar accuracy, recall and prediction. The reliance on atheoretical models is particularly dangerous for an attempt to predict change. If we for instance rely on a simple rule to anticipate future events like “tomorrow’s weather will be like today’s weather”, we will end up with forecasts that in no situation included the prediction of a change. A naïve forecasting model can for instance try to forecast state failure based on the assessment of whether or not a country has experienced this fate before. Such a forecasting model might “explain” the variance of state experiences in the statistical sense. As it is not based on a solid theoretical mechanism, however, it fails in identifying the moments when a fragile country would tip from relative stability to the widespread usage of political violence.

1.4 Selection of approaches for predicting social tipping points

In contrast to Taleb (2007), we therefore contend that predicting social tipping points is not necessarily more difficult than forecasting radical environmental change. And we claim that social science research is able to identify the causal chains that lead to disruptions – a necessary requisite for discovering patterns, trends and discontinuities, and ultimately for forecasting “social tipping points”.

The literature on the prediction of social change has made rapid progress in recent years. We will differentiate between *structural*, *dynamic* and *game theoretic approaches* to the prediction of social and political outcomes. The study will present, based on a thorough review of the available literature, the key findings from political science and sociology and discuss which of the three approaches is useful in which context. We will also highlight the data problem that renders the task of predicting social change quite difficult. Because much relevant information is, if anything, only available at a high level of temporal aggregation like the year or the quarter year, we need to find proxy information to predict sudden changes. A further problem that we identify and discuss is the problem that tipping points are often equated with dramatic changes. However, such extreme events are rare and therefore not easy to predict, not least because most indicators that are used to predict less dramatic changes are also only slowly varying over time, not heralding at all the possibility that social behaviour might “tip over” to some other social equilibrium in the near

5 The state capacity model predicts that weak states in which the government cannot credibly deter rebels fall victim to civil war. The original contribution by Fearon / Laitin (2003) operationalized state capacity through economic development as expressed through the gross domestic product (GDP) per capita and the percentage of a country’s terrain that is mountainous. The original “greed” model by Collier / Hoeffler (2004) maintained that countries rich in natural resources face a higher risk of civil war. These authors have qualified their contributions in subsequent publications (e. g. Collier / Hoeffler / Rohner 2009).

future. We will conclude our study with a discussion of how sudden social stress can be managed over time.

1.5 Study outline

To sum up, this study answers the following questions:

- What are social tipping points?
- Where and how do social tipping points emerge?
- How can social tipping points be predicted?
- How can the study of tipping points contribute to early warning in development policy?

In section 2 we will define “social tipping points” and present the key characteristics of “fragile” states where social tipping points typically occur. On this basis we propose our theoretical understanding of a social tipping point situation. In section 3 we will discuss the strengths and weaknesses of three theoretical approaches for the prediction of social tipping points and consider thereby three important problems to be solved for accurate tipping point prediction. Section 4 offers insights in how the analysis of social tipping points informs planning of development policies and how it fits into early warning initiatives. A concluding section 5 rounds up the analysis and gives hints to further avenues of research.

2 Definition of key concepts and introduction of a theoretical model

2.1 Social tipping points

Following Scheffer et al. (2009, 53), we define tipping points as “*a sudden shift to a contrasting dynamical regime*”. Social shifts that are investigated by political scientists and sociologists deal with shifts at the state or society level and include for example the transition from peace to war, from autocracy to democracy, from a stable state to a collapsed state or from an integrated to a segregated society. We call this kind of tipping point a *social tipping point*. In contrast to natural scientists (Scheffer et al. 2001, 592–593), we do *not* assume that the outcomes of social tipping points are *irreversible*. On the contrary, violent conflicts may collapse back upon themselves, quickly democratized regimes may fall back into authoritarian rule, collapsed states may regain former strength and capacity, and segregated societies may find way back into societal integration and inclusion. Furthermore, we do not necessarily presume that social tipping points have to be *solely negative* for a society. Without doubt, the consequences of civil war or genocide are dreadful because thousands of innocents are physically and mentally harmed and entire communities are traumatized. But a social tipping point can also represent the chance for an overdue political reorganisation of a state. There are for instance many post-communist states which have narrowly escaped the danger of state failure and have embraced political and economic freedom. These and similar transitions have also opened new windows of opportunity for the population. But to make a new start and to make constructively use of a

social tipping point, all tipping point situations require *ex post substantial societal adaptation* in social, cultural, political or economic terms.

A difficult point to define is the time dimension of a “sudden” social shift. Some spells of abrupt change, like for example the collapse of the Communist Czechoslovak regime in November 1989 or the outbreak of the genocide in Rwanda in April 1994, have indeed occurred within a matter of hours. But in almost all cases, such shifts are the result of a longer term change in the social, political and economic order of a country resulting in the destabilization and (near) failure of the regime. Such shifts manifest themselves for example in the emergence of an economic crisis, a legitimacy crisis, or a performance crisis as in the case of Czechoslovakia and of a political power crisis in combination with a social exclusion crisis as in the Rwandan case. In such an unstable situation, one extreme event can trigger a “sudden” shift: in the Czechoslovak case it was the breakdown of the neighbouring Communist regimes that triggered the transition to democracy, and in the Rwandan case it was the murder of the Rwandan president that triggered the genocide. But to make it more explicit, none of the triggering events could have caused a *social tipping point* alone. Both here mentioned events were the result of longer-term developments in the economic, political and social fabric of the two states. Thus, social science research needs to identify these longer term processes as well as the relevant structural and behavioural patterns that contribute to the destabilization of a country and the sudden tipping over of the relevant processes to new modes of interaction.

2.2 Fragile statehood

Researchers in transition studies consent that a stable and functioning state is a requisite for the peaceful living together of individuals (Linz / Stepan 1996, 28–33). However, there is a long and intensive debate of what a state is and what the state has to deliver to call it “stable” and “functioning” (for an overview see Merkel et al. 2003, 230 and Schneckener 2005). We seek to avoid a normative impregnation of the concept and thus follow the pragmatic approach of Fabra Mata / Ziaja (2009, 5) by characterizing a state according to the following three attributes: *effectiveness* for how well state functions are performed, *authority* understood as the enforcement of a monopoly on the legitimate use of force, and *legitimacy* as the public, non-coercive acceptance of the state. “State capacity” is thereby at best classified on a continuum of all three attributes: the more a state provides goods and services to its citizens (*effectiveness*), the more it is able to enforce a legitimate monopoly on the use of force (*authority*) and the more it allows for political rights and civil liberties and is accepted by its people (*legitimacy*), the more stable and functioning it is. Vice versa, a fragile state is not as capable as expected by its citizens in fulfilling its responsibility as a provider of the monopoly of the use of force, of a functioning political order, and of basic services and public goods, which in turn undermines its legitimacy. According to the different stages on the stability-fragility continuum, fragile states can be classified as either “failing” or “failed”. “Failing states” perform necessary state functions just partially, while “failed states” have already ceased to perform the envisaged functions (Chesterman / Ignatieff / Thakur 2005; Ignatieff 2004; Rotberg 2004). Two aspects remain to be noted: First, the concrete threshold of when a state can indeed be called “fragile” varies over the different state fragility indices used in social science (for an overview see footnote 7). And second, the notion of a “failing state” is open to the direction of further

development of state capacity; that means the state can either continue to complete state failure or it can regain strength and develop its capacity towards a more stable state.

For a long time now proponents of globalization and transnationalization have hypothesized the end of the state, or, at least, have postulated its limited capacity to govern in a globalized world (Baskin 2003; Ottaway 2003; Risse 2005, 2007). Nevertheless, the state remains still the most important model of social organisation (Kritz 1996); and there is hardly any legitimate and equally capable and fair institutional alternative to a functioning state (Krasner 1999).⁶ That is why the development community is particularly concerned with the spread of fragile statehood in the developing world.

Fragile statehood is particularly challenging because fragile states tend to become a risk for stability and security at three levels: at the level of their own population, of their regional neighbours and of the international community. At the local level the population is threatened by the limited capacity of the state to control and perform the legitimate use of force and to take and implement decisions. The absence of the rule of law endangers the physical security of human beings, and especially weak actors and actors in a minority position remain without protection. The state may tolerate or even support the use of force against its citizens (Batt / Lynch 2004, 6–7; Gurr / Marshall / Khosla 2001). At a regional level neighbours may be destabilized by negative spill-over effects, for example through migration and refugee flows, and the spread of organized crime. Finally, at the global level failing and failed states can become safe havens for terror networks and extremist groups. Fragile states are hardly able to limit organized crime activities like the smuggling of drugs, illegal weapons and human trafficking; to the contrary, mostly leading actors profit from weak statehood and have hardly any interest in re-strengthening state capacity (Batt / Lynch 2004, 6–7). In these states, clientelistic networks, family clans, tribe structures, warlords or terror groups take the place of functioning state organs. They selectively provide security for some parts of the society and insecurity for others while taking exclusionary decisions and extracting resources and distributing them to their followers. Arbitrariness, corruption, and ad hoc decision-making replaces the rule of law (Schneckener 2005, 7). In such contexts, the belongingness to the political community is equally questioned and can in turn trigger (violent) conflict. Accordingly, in our view, the structural context of a fragile state particularly prepares the ground for social tipping points.

There is a widespread consensus about the list of countries that fall into the “fragile state”-category.⁷ However, social scientists are still at loggerheads over the causes of this fragility. The empirical search is accompanied by a discussion of whether such terms are useful at all and whether or not their usage masks certain ideological or material paradigms of the

6 Alternative forms of governance or „governance without government“ shall not completely be denied here (see interesting considerations in Kötter 2007; Risse 2007; Schuppert 2008); however, in our view, alternative concepts will remain limited to partial governance functions.

7 Fabra Mata / Ziaja (2009) identify 11 indices that focus on measuring fragility at the country level, provide numerical scores on for at least 75 states and are thus potentially suited for cross-country comparisons. Among the most prominent index providers, the World Bank (2009) delivers an index for „Low-Income Countries Under Stress“ (LICUS); the Fund for Peace (2010) proposes the „Fragile States Index“; and the OECD (2010, 145) provides a list of fragile states encompassing low-, middle- and high-income countries in its annual report „Resource flows to fragile and conflict-affected states“ using three fragility indices in combination, namely the Country Policy and Institutional Assessment (CPIA), the Index of State Weakness in the Developing World and the Country Indicators for Foreign Policy.

industrial world or the development community. Be that as it may, we contend that it is of utmost importance to explain and predict the process of when a state or society embarks onto a social tipping point.

Unfortunately, the literature on fragile states does not provide us with a definitive list of factors that would help us to forecast which countries are at a particular risk of becoming “failures”. In his masterful treatise “When Things Fall Apart”, Bates (2008, 20) maintains for instance that the possibility of political order depends on three factors, namely the level of political revenues, the rewards from predation, and the rate of discount that the actors who possess the possibility to use violence attach to a relatively cooperative course of action. In his view, many African states have endured various forms of state failure that resulted from economic shocks and the subsequent erosion of public revenues. In such a crisis, it becomes more and more attractive to use force to maintain or gain access to alternative income sources, most notably rents accruing from the exploitation of natural resources. Goldstone et al. (2010), by contrast, maintain in a macro-quantitative evaluation that partial democracies with factionalism and armed conflict in neighbouring states are key drivers of two forms of instability, civil war onsets and adverse regime change. This lack of consensus on the necessary and sufficient conditions of social tipping points is the reason why we develop an encompassing theoretical model based on rational choice thinking in the next section.

2.3 Our theoretical model of a social tipping point situation

One of the key problems in the social and natural sciences is the prediction of extreme events where a society suddenly moves from one equilibrium to another one. Quite often, researchers rely on Schelling’s (1971, 1972, 1978, 147–155) tipping model or extensions thereof, which is also known as the “segregation model” (Ruoff / Schneider 2006), to account for such radical changes. In this innovative contribution, Schelling showed how social segregation in urban areas becomes the outcome even if neighbours only have a mild preference to be among their own and would tolerate to live in a multicultural society to some extent. According to Schelling’s model, it only takes a marginal increase in the number of residents with a particular ethnic background to provoke the flight of other groups from this neighbourhood.

In an early influential social scientific model of tipping processes, Granovetter (1978) considers how a group beset by collective action problems is able to overcome this challenge and to change the social rules by tipping over a threshold. We model such behaviour below as a social interaction between competing social groups where one side profits from the status quo whereas the other ones suffer under it. Our graphical identification of ideal typical tipping point processes refers to two groups. The analysis can be translated without any loss of generalizations to multilateral interactions.

Our models are based on the supposition that most cases of state fragility are based on some sort of distributional conflict in which the bone of contention can be territory or access to public goods. The assumption that tipping processes can be traced to socio-economic cleavages is gaining ground in the fragility literature (Bates 2008). It also fills a certain void in the research on civil unrest which has for a long time neglected to pay sufficient attention to inequalities between groups and the resulting distributional conflicts.

Income polarization between groups has theoretically discovered to be very dangerous when two equally strong groups oppose each other, one of them richer, one of them poorer (Esteban / Ray 1999, Esteban / Schneider 2008). Østby (2008) shows in an empirical application of this polarization thesis that extreme horizontal inequality crucially affects the risk of social turmoil.

We assume in line with this emerging literature that the resulting social tipping processes largely result from economic discrimination which often goes hand in hand with political discrimination. Obviously, it is also imaginable that social turmoil results from the latter form of inequality alone. Such a political model of tipping processes, however, begs the question why the privileged group engage in discrimination against an excluded group at all. In other words, if we do not want to study inequalities by simply noting that they are present, we need to motivate their occurrence theoretically. We believe that economic factors like the ones studied below are crucial in this respect and that our assumption that many social tipping processes have socio-economic roots is well justified.

To understand the eruptive nature of the resulting distributional conflicts, we differentiate between endogenous and exogenous tipping point processes and assume for simplicity that a country finds itself in a situation where the groups co-exist with each other based on an unfair social contract benefitting group A at the expense of group B. Of course, such a contract and its implementation can be based on a peaceful agreement, but can also result from the threat or usage of oppression. This status quo outcome, which is for reasons of simplification situated on the contract curve (i.e. the set of socially optimal outcomes), is denoted as c_{ij} , while the fair outcome f_{ij} , which is equally located on the Pareto frontier, represents a division of the welfare of a society that both sides would consider to be fair given their strength and productivity. Both groups are considered to be equally strong in terms of group size. In Figure 1A, the tipping process starts out with a negative exogenous shock to a society, while in Figure 1B the shock is positive. A negative shock leads to a shift of the contract curve towards the origin; a positive one moves the set of feasible outcomes in the opposite direction. Both groups can invest in unproductive conflict activities. The social loss L_{ij} that results from these rentseeking activities is maximized if the groups are equally strong (Esteban / Ray 1999, 2008).

A negative shock which moves the contract curve to the origin can result from a sudden change in the economic or political change that a society has to endure and which cannot be met with automatic stabilizers. Dramatic negative shocks are the involvement or endurance of major crises and violent conflict in neighbouring states. Note that the shift of the contract curve does not mean that the dominant party A is able to defend necessarily the privileged position. Even if the costs of the shock are equally paid by the two groups, it is not guaranteed that the underprivileged side does not want to challenge the current profiteers. It is indeed the case that reduced possibilities render conflict more likely as the opportunity costs of fighting are reduced. However, fighting is also less attractive as there are fewer means to be conquered through force (Fearon 2008). There is nevertheless quite some evidence that poorer countries have more difficulties in dealing with exogenous shocks, increasing the risk that such societies embark onto a course of self-destruction. Note that such negative shocks can also be of a temporary nature and for instance follow from policy shifts such as foreign economic liberalization (Bussmann / Schneider 2007). It is also important to note that the experience of a shock does not automatically translate into a tipping process. The groups have to make choices and to invest in conflict if they

believe that moving away from the transformed social contract is in their interest. Hence, not all negative shocks in the form of earthquakes or other natural disasters translate into a civil war, although there is increased risk that a country goes through such a social escalation after such a devastating experience (e. g. Nel / Righarts 2008).

Figure 1B depicts an almost analogous process in which a society suddenly faces a positive economic shock. This can happen as a consequence of the discovery of natural resources. The anticipated rents create an incentive to renegotiate the social contract or, if this fails, to start using force. Note that actors will invest more in conflict in such a situation as the expected gains from conflict have grown. This indicates that the risk of state failure can grow in the wake of positive growth shocks, as some proponents of the resource curse thesis maintain despite the conflicting evidence (Brunnschweiler 2008; Brunnschweiler / Buthe 2008).

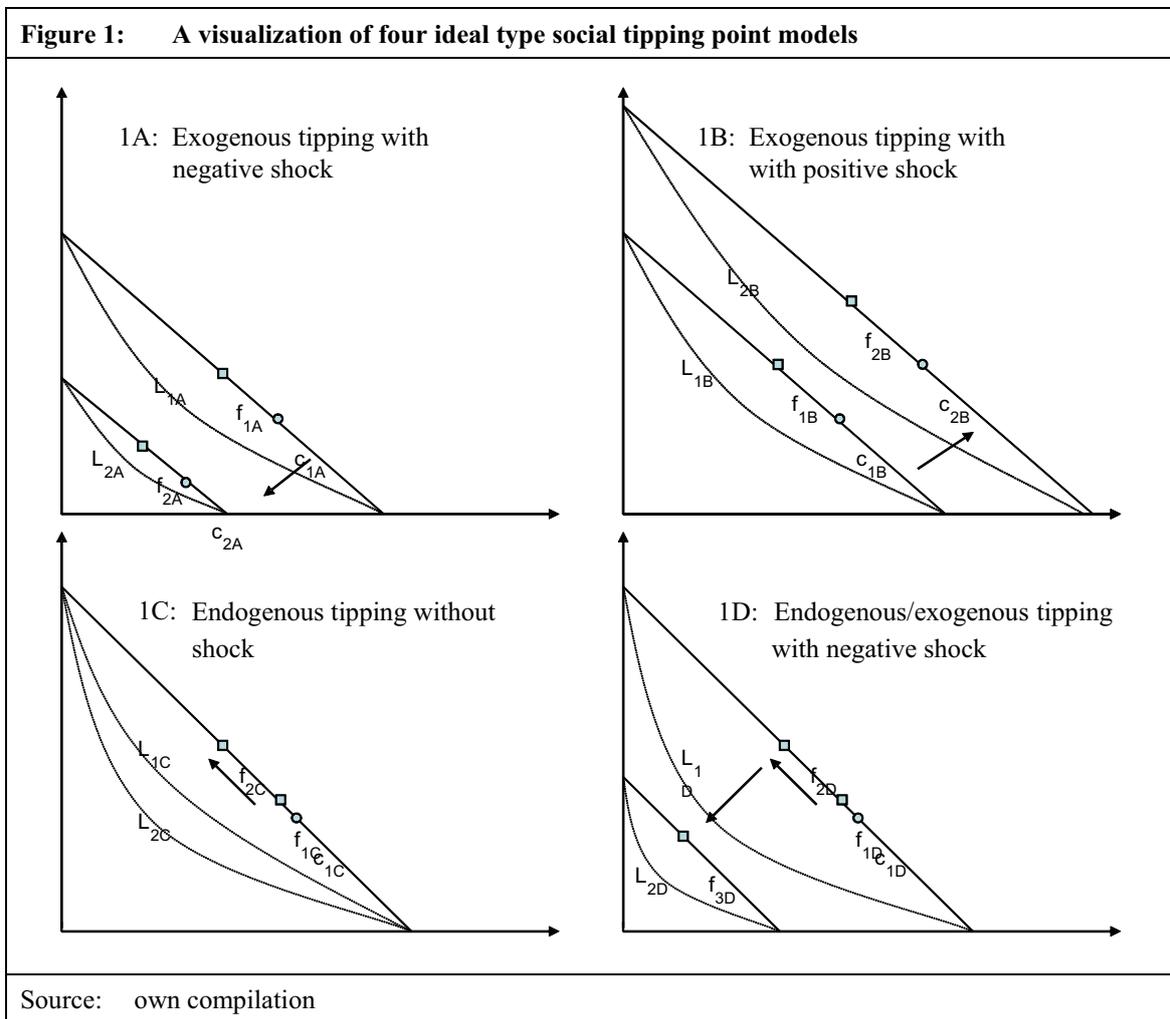
Obviously, a society does not only reach the nadir where cooperation tips over into anarchy through outside forces it cannot control. On the contrary, the intellectually most challenging situations are probably endogenous societal changes like unequal economic productivity which increase the imbalance between the contending social groups and which render the fragile social contract more and more unsustainable. Indeed, the risk of social eruptions has frequently been equated with youth bulges which are particularly dangerous if they affect contending social groups very differently (Urdal 2008). Endogenous tipping refers to processes within a society that lead to a challenge to the often unjust social contract. Such a constellation is depicted in Figure 1C in which through an unequal development between the groups the “fair” division of the spoils move from f_{1C} to f_{2C} . Note that the social loss due to investment in political violence becomes according to Esteban / Ray (1999) larger the more polarized a society is. In Figure 1C, the different size of L_{1C} and L_{2C} represent this divergence.

In reality, tipping processes most often contain endogenous as well as exogenous triggers. Such a synthesis of the processes is represented in Figure 1D where a society, in which one group grows at the expense of the other one and is therefore increasingly able to challenge the unfair status quo, falls victim to an external shock. It is most likely that such a country is at a high risk of anarchy as the redistributive conflicts grow in line with the increasing awareness that the social contract is untenable. Brancati mentions the cases of Colombia in 1999 and El Salvador in 1986 to illustrate that “*earthquakes have not only failed to foster peace but have seemed to spur intrastate violence as well*” (2007, 716).

What this last model suggests is that a combination of exogenous and endogenous forces increases the risk of social breakdown. This means for the study of state failure and instability that additive regression models that disregard the likely impact of this interaction most likely underestimate the risk for many states. This is especially true in times of a global economic crisis in which the distributional conflicts intensify. It is not surprising in this light that many historians have attributed an increasing polarization of the societies in the wake of major economic downturns (Esteban / Schneider 2008).

The conjecture that social tipping processes are very often driven by the interaction of exogenous and endogenous forces does not necessarily mean that the individual processes contributing to state fragility are non-linear. Indeed, the models that are used in the natural sciences to predict the tipping over from one state into a qualitatively very different equi-

librium are often highly deterministic. In the social processes studied here, there is quite often an element of chance which forbids the researcher from adopting the methodologies developed in the natural sciences to predict social behaviour; social actors can make choices whether or not to adopt a certain course of action, while this sort of discretion does not exist in processes where individual humans play a negligible role. Although we do not detail the social processes contributing to state failure here, the competition between contending groups on whether or not the weaker or disadvantaged side should be compensated and how such a deal could be implemented is crucial for the analysis of state fragility. Analytically, the inclusion of a chance element in attempts to predict social tipping processes does not render these studies more complicated than the equivalent forecasting examinations undertaken in the natural sciences. It simply means that the forecasts do not result from a deterministic but rather from a probabilistic model.



In the following, we will discuss whether the social sciences are able to deal with the double challenge of forecasting endogenous and exogenous tipping processes. Our central argument boils down to the contention that the different approaches in predicting social tipping points serve different purposes. The consequence of these diverse goals is that the

ideal type research designs outlined below have a differing capacity to meet the problems of predicting the social and political breakdown of states. While longitudinal approaches which typically involve panel data on a number of countries might be adequate for the study of endogenous tipping processes, the competing approaches outlined below might be more fruitful for the analysis of exogenously determined processes.

3 Approaches for predicting tipping points

The social science literature on forecasting dramatic events like state failure, genocide or war falls into three main categories: *structural*, *dynamic* and *game theoretic approaches* (see also Schneider / Gleditsch / Carey 2011). We will introduce these competing methods in the following and argue that they complement each other and that they all have special merits and weaknesses.

Our review of the literature indicates that no forecasting technique or model is superior in all contexts. However, we suggest in the following which approach might be adequate in a particular attempt to forecast social tipping points. In our view, the key problems of forecasting political events are threefold. First, prediction crucially depends on the reliability of the information used for the forecast. This means that a prediction is only as good as the data that the researcher feeds into the empirical model (*information problem*).⁸ Second, configurations in which a society risks embarking on a disastrous course are seldom. This rarity renders the prediction of sea-changing events more challenging than the forecasting of routine developments (*rare event problem*). Third, many tipping events are highly extreme and therefore of a magnitude that applications of a standard model cannot capture or that is beyond conventional theorizing attempts (*extremeness problem*).

Table 1 shows how the three approaches differ with regard to these challenges. A positive sign indicates that the approach is able to deal with this challenge, a negative sign that the problem is often insurmountable. We provide a detailed assessment below.

	Information problem	Rare event problem	Extremeness problem	Applicability
Structural approach	–	+	+	Risk assessment for many cases
Dynamic approach	+	+	–	Predictions for many periods within one case
Game theoretic approach	+	–	+	Single-shot predictions for one case at a time

Note: “+” indicates that the approach can deal with the problem; “–” indicates that the approach cannot deal with the problem.
 Source: own compilation

8 This often leads observers to complain that a particular disaster could have been prevented because the relevant information was allegedly present at the critical juncture. This sort of ex post facto counterfactual was made, as mentioned by Feil (1998, 3), with regard to Rwandan genocide in 1994.

3.1 Structural approaches

Structural approaches try to predict the risk of a geographical unit (whether a country, a region, or a town) experiencing a certain behaviour in subsequent time periods given important structural characteristics of the unit at present. The structural approach has been used for the analysis of interstate conflict (e. g. Choucri / Robinson 1978), refugee movements (e. g. Schmeidl / Jenkins 1998a), complex humanitarian emergencies (Harff / Gurr 1998; see also Schmeidl / Jenkins 1998b), genocides and politicides (Fein 1992; Harff 1998, 2003; see also Harff / Gurr 1998), ethnic conflict (Gurr / Moore 1997; Gurr 1998, Moore / Gurr 1998; Gurr / Woodward / Marshall 2005; see also Tellis / Szayna / Winnefeld 1997), state failure (e. g. Goldstone et al. 2000; Goldstone et al. 2010; King / Zeng 2001; Carment 2003), general political instability (e. g. O'Brien 2002), civil conflict (Weidmann / Ward 2010), and human rights violations (Poe / Rost / Carey 2006).

Researchers who rely on the structural approach typically rely on cross-sectional data; this design allows the researcher to predict the risk that a country or region will fall victim to a civil war, a human emergency or state failure, or will experience one or several terrorist events. The variables that are used in this context are the structural attributes of a country like for instance its level of democracy, economic development or ethnic fragmentation. To include dynamic aspects in their estimations, researchers frequently combine cross-sectional data at various points in time. The advantage of this pooling effort is an increased ability to predict outcomes precisely. In the resulting, often very large data sets, the country-year or dyad-year are typical units of analysis. The traditional models have mainly taken into account how the country-specific attributes and the dynamics in which these features change affect the risk of a certain outcome. The underlying logic of the statistical models is typically additive and assumes that a unit change in one explanatory factor leads to a change in the examined risk that is the same across all countries with the same manifestations on the independent variables.

These underlying assumptions are questionable in several respects. First, it is questionable whether the underlying factors follow an additive logic in their influence on the outcome of interest. Second, the traditional approach does not take into account that the units of observations are not only temporally interdependent on each other, but also spatially. This means that a state failure in country A increases the risk that states that are closely connected to this country also risk to experience a breakdown. It is in the light of these questionable assumptions not surprising that the structural approach has recently seen the import of classification techniques such as neural network algorithms from computer science and other disciplines (Beck / King / Zeng 2000; Rost / Schneider / Kleibl 2009). Such approaches allow the researcher in particular to move beyond the additive logic of standard econometric tools and to take non-linear relationships within the data into account. Also, the usage of cutting-edge econometric tools that consider the spatial interdependencies of the units of observations leads to forecasts that are sensitive to geographical consideration or the importance of social networks (Ward / Gleditsch, 2002 and related contributions).

The article by Rost / Schneider / Kleibl (2009) serves as an illustration of the advantages and disadvantages of the structural approach. The authors have contrasted logit regression models with neural network models and provide *ex ante* forecasts of the risk of civil war

for the years 2008 to 2012.⁹ The authors contend that with a relatively simple model and with the help of publicly available data sources meaningful civil war risk assessments can be computed. It should, however, be noted that only one country, Nigeria, is predicted by both methods to belong to the five countries with the highest risk of a civil war. The longitudinal logit model also includes the Central African Republic, the Democratic Republic of Congo, Thailand, and Pakistan among the countries with the highest risk. The neural network model, in addition to Nigeria, classifies Eritrea, Haiti, Côte d'Ivoire, and Cambodia as being among the most dangerous places with regard the risk of civil war. In the social science context, forecasts have up to now mainly been made with regard to the forecasting of wars (e. g. Beck / King / Zeng 2000, Rost / Schneider / Kleibl 2009), but obviously the same techniques could be employed to predict other attributes of extreme forms of social instability.

The diversity in the two rankings indicates that generating risk assessment models with the help of the structural model partly depends on the methodology. Further problems of the approach are the high level of temporal and spatial aggregation. This is especially a limitation in the light of the slowly changing nature of most covariates. When fragile societies tip over from a precarious peace to intensive violence, some sort of sudden change most likely is at least partly responsible for these transitions. While the structural approach is able to identify some of the attributes of increasing risks, dynamic models of social change are more promising in dealing with the escalation processes that precede the breakdown of societies and the unleashing of unprecedented violence.

In the absence of sound micro-level information, structural forecasts often resort to publicly available macro-level information. This is, however, often problematic insofar as these indicators do not vary much over time. It therefore does not come as a surprise that predictions of politically shaped processes that resort to such limitedly useful data are often rather shaky. Attempts like the best-selling "Limits to Growth" by Meadows et al. (1972) to forecast the long range fate of the globe, which were very popular in the 1970s and 1980s, are one illustrative example of the difficulties in delivering accurate predictions based on macro-level data. The failure of these models is not only related to the data that are used. A further problem is, of course, the extended time horizon that has largely neglected the possibility that policy innovations, technological progress or the discovery of oil reserves would offset the Malthusian doomsday logic of the original forecasts.

However, highly aggregated data can be useful in attempts to predict certain outcomes in the medium term; this means a time range of one up to five years. This is the area where the structural approach seems particularly relevant; this approach helps to make risk assessments and to limit the more detailed analysis to those political units which particularly face the risk of undergoing a critical juncture. Such analyses can also be conducted at lower levels of geographical aggregation as the innovative forecasting exercise by Rustad et al. (2011) demonstrates. They break new ground in using the structural approach to predict conflict through an innovative combination of national- and regional-level data. The

9 Logit models enable the researcher to predict the risk of a binary outcome given specific attributes. In the forecasting studies discussed here, neural network models serve the same purpose. They stand, however, more generally for a research tradition in computer science. Neural network algorithms have been developed as a classification tool that involves for instance learning algorithms and thus elements that are not included in logit regression predictions.

examples of Nepal and the Philippines highlight provinces that are expected to be particularly conflict-prone. The country-level approach that has prevailed in studies on civil unrest until recently misses addressing such intra-country differences in assessing the risk of state failure.

The structural approach nevertheless faces severe challenges even when the time horizon of the forecasts includes lower-level information and is limited to the short term. First, the information which is necessary for generating the forecasts might be unreliable or missing. This dual problem is particularly relevant for forecasting exercises where one tries to predict events or trends that are largely dependent on the level of development of a country as input information. Hence, complete and accurately assembled statistics often do not exist for those countries in which public institutions have failed to an extent that violence seems imminent. Second, some structural indicators are inadequate for forecasting short-term events or trends if they are aggregated at a higher level. For instance, if an analyst wants to assess the risk of conflict next week based on the observation of escalatory tendencies this week, even using indicators disaggregated monthly does not make sense.

3.2 Dynamic approaches

Like structural approaches, dynamic approaches equally try to predict the risk of a geographical unit experiencing certain behaviour in subsequent time periods with regard to certain key structural characteristics of the unit at present. In contrast to structural approaches however, scholars frequently resort to time-series designs. As they use shorter time intervals in these applications, some of the problems of the structural approach are circumvented. There are for instance numerous attempts to predict the further evolution of political violence within a particular conflict area like Kosovo (Pevehouse / Goldstein 1999) or the Levant (Schrodt / Gerner, 2000; Brandt / Freemann / Schrodt 2011; Schneider 2012). As outlined below, it is of particular interest to the development community to predict conflict dynamics for countries that it considers to be at a particular risk of experiencing high levels of fragility. The main problem here is, however, a structural one as only scientifically sound global analyses help to sort out the countries which are at a high risk of undergoing such a detrimental periods and those where the equivalent risk is relatively low.

For the study of particular conflicts the use of so-called event data is one of the most frequently used types of information. Event data like for instance the Kansas Event Data System (KEDS) rely on computerized content analysis of newspaper reports to categorize cooperative and conflictive events that occur between a sender and a target actor (see Goldstein 1992 for the coding scheme and Pevehouse / Goldstein 1999 as well as Schrodt / Gerner 2000 for KEDS applications). One can create levels of cooperation or conflict between these dyads at many levels of temporal aggregation, ranging from the daily (Schneider / Troeger 2006) to the quarterly or yearly level of interaction. Event data has also been used as a handy early warning device. This is particularly true for the now defunct “FAST International” project of the Swiss Peace Foundation, which was used by Austrian, Canadian, Swedish and Swiss policy making circles to improve their early warn-

ing and preventive action capacities as well as to refine their development programmes towards conflict-prone countries.¹⁰

One of the key advantages of this approach is, as indicated, the usage of temporally disaggregated data. As some conflicts also receive quite some media attention, it is technically quite straightforward to use Google News or similar services as input for an up-to-date early warning tool. The data gathering becomes, however, much more involved if the media reports are sparse or biased. The FAST project relied on country experts for the data input. This approach faces the similar difficulty as everything depends then on the trustworthiness of the reports that these experts send to the forecaster.

To illustrate the pros and cons of this approach, we briefly summarize the state-of-the art contribution by Brandt / Freeman / Schrodt (2011). Their forecasting tool, which overcomes some of the limitations of the structural model, in particular the usage of highly aggregated information or incomplete data sets, is tested through event data-based forecasts for the conflict between Israelis and Palestinians for 2010. One of the key innovations is the incorporation by Brandt / Freeman / Schrodt (2011) of expert judgement in the form of Bayesian prior probability assessments of their research assessments; these assumed probabilities are based on existing theoretical and empirical work on conflict dynamics. To produce the forecasts, the authors employ two advanced times series approaches that follow the logic of Bayesian inference: Bayesian vector autoregression (BVAR) and Markov-switching Bayesian vector autoregression (MS-BVAR) models.¹¹ These models allow the inclusion of what possibly comes close to a tipping process, namely phase shifts in the behaviour of the conflict actors. Using the automated coding software TABARI, Brandt / Freeman / Schrodt (2011) provide weekly forecasts for the conflict between Israelis and Palestinians in real-time.

The main advantage of single conflict time-series designs is the possibility to model the dynamics within a particular conflict more precisely. However, this advantage comes at the price of reduced external validity, as the conflict trajectories do not necessarily resemble each other across different conflicts. The limited usefulness of macro-quantitative political data for predictive purposes is the reason why forecasters of political events frequently pursue different research strategies. Time-series forecasts often include input information that is disaggregated to the quarter year, the month, the week, or even the day (Schneider 2012). As official statistics often only provide figures at the monthly or quarterly level, predictions at lower levels of temporal aggregation often refer to events data. Structural models also often make “timeless” forecasts, for example by predicting an increased risk of civil war outbreak for a particular country without specifying within what time frame this outbreak is expected to take place.

10 For detailed information on the FAST International programme please refer to <http://www.swisspeace.ch/typo3/en/peace-conflict-research/early-warning/index.html> (accessed 10 December, 2010).

11 The Bayesian approach in statistics generally uses prior knowledge to estimate the likelihood that a hypothesis can be accepted or needs to be rejected. The approach is based on the Bayes’ theorem in probability calculation and involves the usage of this algorithm in the calculation process. Vector autoregression is an econometric approach that aims to study the relationships between various time series. Markov-switching models allow additionally for the study of series where time series shift from one level to another one.

Judgmental information that is employed to produce predictions does not only take the form of expert views that are directly gathered for the predictive purpose. Indirect expert information can come from prediction markets (Arrow et al. 2008; Wolfers / Zitzewitz 2004) or similar sources like financial markets where a group of independent individuals evaluates a policy that is relevant for economic actors and that can only be ignored at great costs (Schneider 2012). The former information source unites investors who trade contracts yielding payoffs related to an uncertain outcome like an election result or the risk that an escalation process results in war. Prediction markets typically predict political outcomes better than polls (e. g. Berg et al. 2008; Schaffer / Schneider 2005). This is not particularly surprising as the traders are able to include these polls like any other piece of information in their evaluation of how the political market will evolve and because the respondents in a poll are usually not compensated for their willingness to face a polling firm. It is therefore much more astonishing that financial markets can be used as a tool to forecast political events. Schneider (2012) shows that data from the Tel Aviv Stock Exchange can be used to forecast political cooperation in the Levant. Judgmental information of this sort cannot, however, be used very successfully to predict conflict events. This divergence results from the element of surprise that characterizes many types of conflict, not the least its violent forms. Cooperative acts like the signing of a ceasefire, conversely, are often announced before the actual event takes place.

We contend that the surprising nature of many conflictual events often render them more likely candidates for the expertise of individual experts who might be much more familiar with a particular conflict and its escalation potential than the masses or even a group of scholars with high general competence. A further reason to resort to individual experts for the prediction of particularly dramatic events is that such occurrences might constitute a structural break in a particular political process or that their magnitude is so exceptional that the covariates used for the production of longitudinal or time-series forecasts cannot capture them.

3.3 Game theoretic approaches

The third and final approach that is useful for the prediction of tipping point conditions in fragile states is game-theoretic. Bueno de Mesquita and his co-authors (e. g., Bueno de Mesquita / Newmann / Rabushka 1985; Bueno de Mesquita 2011; see also Bueno de Mesquita 2002, 2009 for summaries) have pioneered the application of game theory to prediction. These studies typically rely on detailed information from area experts as the empirical basis; these experts do not predict an outcome of a policy making process, but only provide information on what a conflict is about (“issues”), the positions of the actors on them and how much importance they attribute to a bone of contention. The forecaster then uses these data in strategic models to estimate where the decision making process will end and what policy position is finally chosen.

The approach is, as indicated before, particularly well-suited for the development of comparative model evaluations and has been used to explain and predict patterns of decision making in the European Union (Bueno de Mesquita 2011; Thomson et al. 2006; Schneider / Finke / Bailer 2010a) and elsewhere (Bueno de Mesquita 2002, 2009). The applications by Schneider / Finke / Bailer (2010a) and Thomson et al. (2006) can serve as an illustration. These authors evaluate for over 60 decision making processes in the European

Union which decision making model has the highest predictive accuracy. They show that bargaining models are particularly useful for predicting political decision making processes.¹² The most accurate model is a version of the Nash Bargaining Solution that takes the importance attributed to an issue into account. We believe that such models hold some promise for the analysis of social tipping processes. The most dramatic policy changes in fragile states were almost always preceded by implicit or explicit negotiations between the conflict parties as the rich literature on conflict as a bargaining process starting with Nobel awardee Thomas Schelling (1960) demonstrates (see for example Ruoff / Schneider 2006; Bailer / Schneider 2006).

Some proponents of this approach contend that these models produce very high levels of predictive accuracy (see e. g. Feder 1995, 2002). Yet, the approach has a limited ability to forecast how a process unfolds over time (for a partial exception see Bueno de Mesquita 2011) and does not provide uncertainty measures for the predicted outcome (Brandt / Freeman / Schrodt 2011).

This leads to the third challenge that attempts to forecast international events have to master – the possibility of dramatic, or in other words *extreme*, developments. Bruce Bueno de Mesquita's (2011) forecasting approach seems to be able to circumvent this problem. Within this model-based framework, the opinion of the expert is only used as an input for a forecasting tool that has its foundations in decision and game theory. The main advantage of this forecasting approach is that the level of expertise that is required from an interview partner only relates to evaluating the present. Hence, game-theoretic models that are used to produce forecasts rely on the estimates that the interviewed expert provides with regard to the actors' preferences and power and the importance they attach to various contested issues. Bueno de Mesquita applies the new model informally presented in his bestseller *The Predictioneer's Game* (2009) to a dataset that a multi-national research team had assembled for the evaluation of competing game-theoretic models on the legislative process in the European Union (Thomson et al. 2006). The new model developed by Bueno de Mesquita adds additional complexity to the original framework devised in Bueno de Mesquita / Newman / Rabushka (1985) and later refined in numerous applications. Of particular importance is that this new game-theoretic model allows predicting the behaviour of multiple agents who move simultaneously to reach their goals and who include estimates of the other actors' behaviour and beliefs when they make their choices. The Bayesian updating used in these games offers a fascinating parallel to the time series models presented in Brandt / Freeman / Schrodt (2011). Empirically, the new forecasting models of Bueno de Mesquita performs better than the models presented in Thomson et al. (2006), but slightly worse than one of the adaptations of the Nash Bargaining Solutions introduced by Schneider / Finke / Bailer (2010a). To the authors' knowledge, the approach has not been applied to fragile states. There is, however, no reason why game-theoretic forecasting models should not work in such a context if one can assess the preferences and power of central actors within a given context.

12 These are all out-of-sample predictions as the expert interviews took place before the conclusion of the decision making processes. Information on the outcome of the decision making were gathered through follow-up interviews.

3.4 Comparison of the three approaches: strengths and weaknesses

None of these approaches provides better applications in all contexts. Instead, we believe that while the structural approach is often the only one available for forecasting at the global scale, the rational choice framework is particularly useful for the prediction of single events, which can be of a routine or dramatic nature. This comparative advantage looms particularly large in contexts where only a few experts are able to provide reliable empirical input for the models. Experts are not necessarily more qualified than the uninformed public to forecast the future (Tetlock 2005). In fact, Bosler / Schneider (2011) demonstrate in an empirical analysis that financial markets and thus the decisions made by traders whose main expertise is not on the political side are often better in forecasting the success of ceasefires in the Levant in comparison to the editorial writers of the New York Times or the Jerusalem Post. However, if experts are solely used to provide information on the issues at stake and the positions of the relevant actors, as it is the case with the Bueno de Mesquita forecasting tradition, they can be successfully used (see also Tetlock 2009). If relevant information is available publicly and non-dramatic events have to be forecasted, the time-series method might be more useful, particularly with access to temporarily more fine-grained data.

We nevertheless advocate that development agencies pay clear attention to the different approaches and consider their advantages and disadvantages carefully. Most early warning schemes that they use have relied on the structural approach as Niño Pérez (2004) discussion of the EU Commission's "Check-List for Root Causes of Conflict/Early Warning Indicators" reveals. We believe that this is dangerous as this approach is only able to provide relatively slowly changing information and does not include data on the social escalations processes that characterize a society on the brink of social turmoil.

4 The use of the tipping point concept in development policy

4.1 Applicability of the "tipping point" concept in development policy

We stated in the beginning of this study that social tipping points especially occur in fragile states. These fragile states are important recipients of foreign aid. According to the OECD INCAF statistics (OECD 2010, 50), USD 34.6 billion in Official Development Assistance (ODA) went to fragile states in 2008. That amounted to 31 % of total ODA (excluding debt relief). To avoid a waste of resources aid donors necessarily need to anticipate social tipping points because they need to assess the risk in investing in fragile contexts. A certain level of risk in investment may be tolerable, however, one can assume that in a (near) tipping point situation foreign aid will hardly be invested effectively; and during and shortly after a social tipping point already invested ODA mostly deflagrates without ushering in the intended effects of stability, economic growth and human development (for an overview see OECD 2010). Furthermore, tax payers' money should be invested carefully.

Numerous studies have shown that preventive political action is less costly than reactive political action, not only in financial terms but also in terms of human lives (Brown / Rosecrane 1999). Obviously, nobody wants a second Rwanda or Srebrenica, both symbols for the complete failure of the international community to see conflicts coming and to act

adequately in these crises situations. Thus, also for moral reasons an accurate prediction of tipping points is required. Finally, as Zartman (2001, 153) calls it, there is “such a thing as ‘too late’ ” in a conflict situation, namely when the moment for preventive diplomacy has passed and when it becomes hardly impossible to gain entry into a whole phase of a conflict from the outside. In such a situation, no other means remains for the international community than the very costly use of force or to the bearing of the long-term costs of non-action. Doing nothing increases the chance that states which have endured the stress of a political and social breakdown will collapse again. The protracted state weakness shown in cases such as Bosnia-Herzegovina and Haiti, the anarchy that manifests in contemporary Somalia, and the protracted civil wars in the Democratic Republic of Congo, among others, demonstrate that inaction creates considerable long term costs. Thus, it seems to be much better not to miss the moment for an active preventive policy.

However, transferring social science expertise into effective political action is not an easy task. As a first step, the accurate anticipation of social tipping points requires well-crafted early warning schemes that deliver independent fine grained risk assessments based on comprehensive data that is analysed with advanced social science techniques. Such an early warning unit should possess a list of criteria to discover the signals that announce the occurrence of social tipping points. As a second step, such analyses need to become the bases of political decision-making and policy implementation. Studies need to be read, and experts need to be heard. As a third step, politicians have to deploy the necessary means to moderate the escalation of conflict. The toolbox ranges from diplomatic conflict moderation tools up to military intervention, but they can only be used effectively if the causes of conflict are well assessed and the positions and capabilities of the key actors well-known. Finally, for long term prevention of negative social tipping points, international actors equally need to address the root causes of conflict.

None of these challenges is easily overcome, as the next section will show.

4.2 Challenges of early warning

As argued above, to prevent negative social tipping points in fragile states effective early warning units are a necessity. Early warning initiatives have played a prominent role in development research at least for the last twenty years (see OECD 2009 for an overview). Especially the period immediately after the genocide in Rwanda saw the establishment of several early warning initiatives, including the establishment of the Forum on Early Warning and Early Response (FEWER), the West Africa Network for Peacebuilding (WANEP), the Network for Ethnological Monitoring and Early Warning (EAWARN), and the Early Recognition and Analysis of Tensions (FAST), an initiative of Swisspeace (OECD 2009, 34–35, 50).¹³

A first problem with these initiatives is, however, that they often die out after the first enthusiasm. Reasons for this might be unrealistic expectations, changes in the internal agenda of the supporting development organisation, or scarce financial resources with whom it is hardly possible to fund a large network of experts in a long term horizon. An

13 FEWER and FAST have both closed down by 2009.

illustration of this is the globally acting FAST International program of Swisspeace. Based on local knowledge networks, including the expertise of country desk officers, country experts, and fact-finding missions, FAST collected relevant information on conflictive situations, analysed the data with advanced social science methods and formulated feasible policy options for decision-makers with the intention to guide them to early action. FAST used a comprehensive methodology that combined the advantages of both qualitative and quantitative analyses of conflictive and cooperative trends in the societies under observation. In a 10-year time span from 1998 to 2008 the FAST experts observed developing conflict situations of countries in Africa (Angola, Burundi, Democratic Republic of Congo/Kivu region, Ethiopia, Madagascar, Mozambique, Rwanda, and Somalia), Asia (Afghanistan, India/Kashmir, Kazakhstan, Kyrgyzstan, Nepal, Pakistan, Tajikistan, and Uzbekistan), and Europe (Armenia, Azerbaijan, Bosnia and Herzegovina, Georgia, Kosovo, Macedonia, Montenegro, Russian Federation/North Caucasus, and Serbia). FAST International was utilized by a range of international development agencies, including the Austrian Development Agency (ADA), the Canadian International Development Agency (CIDA), the Swedish International Development Cooperation Agency (SIDA), and the Swiss Agency for Development and Cooperation (SDC). Although of great value to provide accurate information and to draw the international community's attention to trouble spots, due to financial restrictions the project was finished in 2008.¹⁴

A second problem of early warning is the difficulty to get all information necessary to predict social tipping points. Fabra Mata / Ziaja (2009) elucidate these problems with regard to the creation of state fragility indices. Their evaluations show that especially fragile states are characterized by „social mistrust, hidden dynamics and agendas, regime secrecy and lack of infrastructure and capacity seriously [that] hamper any attempt to gather reliable and representative information“ (Fabra Mata / Ziaja 2009, 16). This context does not only affect the validity and reliability of information, but also the coverage for possible explanatory variables. The problem of missing data for certain indicators or time periods, especially in the past, renders forecasting difficult. Furthermore, a time lag of one or two years in data publication is particularly problematic for the measurement of quickly changing phenomena. Thus, early warning initiatives require conducting intensive data coding, expert surveys and opinion polls by themselves to get access to essential information. Such endeavours are costly, and this may further discourage development agencies to invest in early warning systems.

A third problem of early warning initiatives is that their analyses are seldom unbiased and neutral, or in other words, most of policy-oriented early warning initiatives follow an individual and thereby necessarily partial policy agenda. The International Crisis Group (ICG), working on early warning for 15 years now with an annual budget of approximately US\$ 15 million (ICG 2010, 47) sets a prominent example. After the closure of FAST and also of FEWER, the ICG is the only remaining early warning initiative that is acting globally. According to their mission statement, the ICG is “an independent, non-profit, non-governmental organisation committed to preventing and resolving deadly conflict”.¹⁵ Its publication record is impressive, providing easily accessible and understandable information about around 60 crisis countries around the world. However, all their

14 See footnote 6.

15 See for further information <http://www.crisisgroup.org/en/about.aspx> (accessed 10 December, 2010).

analyses come with a strong element of policy advocacy both in “moral, legal, financial and political” terms (ICG 2010, 5). Furthermore, critics find fault in the ICG’s reports and briefings with a lack of consistent theoretical or conceptual frameworks, a certain kind of selectivity in interviewing only high ranking politicians in the countries under watch, in picking up information from biased local sources, in a tendency to use one-sided language, and in a lack of indication of sources supporting their arguments with empirical evidence.¹⁶ Thus, a stable financial basis and a large network of high ranking former politicians and diplomats are no guarantee for balanced crisis assessments and unbiased recommendations for preventive action.

A fourth problem is to transform early warning assessments into adequate political action. While political and military short-hand instruments in crisis situations must be quickly deployable, at any time, and to any part of the world, there is also a need for long term and comprehensive strategies to address the structural root causes of conflict. The analysis of the conflict prevention and early warning mechanisms of the European Union reveal the challenges that need to be solved in order to make a conflict prevention strategy effective (Kronenberger / Wouters 2004, 574–582). Firstly, to raise coordination and coherence, but to avoid double work and lack of information, short term and long term strategies need to be matched. Secondly, to invest scarce resources effectively, responsibility and accountability for budget spending needs to be clarified. Thirdly, to enhance rapid reaction capacity, all instruments of conflict prevention and moderation need to be useable at short notice and staff members need to be trained accordingly. Fourthly, to avoid duplication of work and loss of resource at the international level and thereby in the end also loss of credibility of all actors involved, organisations need to agree on a framework of division of labour. In the case of the European Union this concerns foremost the Council of Europe, the Organization for Security and Co-operation in Europe (OSCE) and the NATO who all are involved in conflict prevention in Europe, but also beyond. To all these challenging questions answers need to be found to avoid that they turn into shortcomings which could aggravate even further the near tipping point situations in fragile states.

Finally, the problem of assessing the effectiveness of early warning and the political action based on it remains. Early warning initiatives share the evaluation problem with the measurement of the effectiveness of development cooperation and democracy promotion (for an overview on challenges and methods see Faust / Neubert 2010). The evaluation of the effectiveness of early warning is further exacerbated by the fact that their benefits are usually unnoticed. In the best case, a near tipping point situation like strong ethnic tensions does not develop into a tipping point, in our example the outbreak of an ethnic civil war that would have devastating consequences for the members of the affected society. As the Macedonian case that was mentioned above showed, it is a mixture of external and internal factors that contribute to conflict prevention. Thus, external early warning and the political action by external actors that is based on it can hardly alone prevent social tipping

16 See for critical statements on the ICG in general: <http://www.hartford-hwp.com/archives/27a/201.html> (accessed 10 December, 2010) and: <http://newleftreview.org/?view=2841> (accessed 10 December, 2010); and on critical analyses of their reports in particular http://www.sangam.org/taraki/articles/2006/12-12_IGC_Report.php?uid=2114 (accessed 10 December, 2010) and: <http://www2.reliefweb.int/rw/RWB.NSF/db900SID/YSAR-6XRLPX?OpenDocument&rc=3&cc=mmr> (accessed 10 December, 2010).

points. Nevertheless, early warning can and has to raise public awareness about near social tipping point situations that urgently need intervention and conflict moderation.

4.3 Conditions for successful early warning

In essence, to be a successful tool for preventing social tipping points, early warning initiatives should include the following activities:

- the systematic collection of event data and expert assessments of crisis regions to allow systematic crisis forecasts;
- the analysis of the data based on advanced qualitative and quantitative social science techniques using the strength of both approaches;
- the development of strategic response scenarios to these crises and the assessment of their intended and unintended consequences; and
- the unbiased, impartial, and independent presentation of policy and implementation options to decision-makers, knowledge disseminators, and conflict moderators.

Early warning initiatives need to be neutral and fair in their assessments, include local expertise, hire experts from all over the world that are well trained in conflict assessing methods and techniques, and be independently funded on a long term basis. And they should have a strong link to responders or response mechanisms.

5 Conclusions and recommendations

Scientific predictions are a necessary first step if we attempt to counteract dangerous social escalations or tipping processes. Counter-measures may come too late or in an inadequate size. In some areas like climate change or nuclear war, scientists provide timely warnings on a regular basis. The “doomsday clock” of the Bulletin of the Atomic Scientists which is supposed to indicate “how close humanity is to catastrophic destruction”, is a telling illustration.¹⁷ The considerable risk for some states to fall victim to massive internal destruction is not matched with a similar international early warning mechanism.

5.1 Main findings

We have argued in this study that the international community should provide permanent early warning for the countries that face a considerable risk of internal breakdown. Although some initiatives exist, the early warning system needs to be global in scope, politically unbiased and scientifically sound. Obviously, early warning is no panacea. It may lead to the wrong policy prescriptions if based on the wrong theoretical or methodological foundations (Ward / Greenhill / Bakke 2010).

¹⁷ See <http://www.thebulletin.org/content/doomsday-clock/overview> (accessed 10 December, 2010).

The choice of a particular prediction technique depends on the expected nature of the anticipated trend or event and on the quality of data that a researcher intends to feed into the model. In our view, the structural approach is able to provide relatively rough predictions of the risk that might beset a certain country or a certain region in the future. The prediction of which countries might fall victim to war, for instance, is similar to the seismological attempt to assess which regions of the world face what sort of risk of experiencing an earthquake. By contrast, the time-series design does not allow such sweeping comparisons, but strives to provide accurate assessment for one particular process only. The point predictions allow an assessment of how large the magnitude of a particular event might be. Temporarily finely disaggregated data, available on the Internet or from financial or betting markets, enable forecasting of a single process. However, not all relevant information is publically available, and we may want to predict structural changes. Hence, in some instances we may need to resort to the rational choice forecasting model, which allows the researcher to forecast events that experts have assessed as political options of one or several stakeholders in a political decision-making process.

Although each the three approaches presented here seem to have certain advantages in a specific context, it should not be necessary to use them in isolation from each other. Scientific progress will only be achieved if we start to run comparative model evaluations across different modelling traditions, including both quantitative and qualitative assessments, like large-n statistical analysis in the former and like expert advice in the latter case. Up to now, such competitive endeavours have been confined to one particular class of forecasting models as O'Brien (2010) and Thomson et al. (2006) show. For instance, such exercises could deal with the question of when the time-series and rational choice approaches expect the onset of a crisis and in what magnitude. An increased level of dialogue between forecasters might also benefit the policy community. For example, it might be feasible for the academic side to provide early-warning models that combine elements of the ideal-type designs presented here. It seems possible to predict the risk of conflict for a set of actors and then employ the other designs to evaluate for the high-risk countries the potential that the structural crisis of the state really escalates into the use of armed violence. In other words, the field of forecasting international relations faces considerable academic and practical challenges that amply show how much progress has already been made.

5.2 Recommendations

More precisely, our study leads to the following recommendations:

- International development assistance should incorporate a double approach to early warning. While it is mandatory to use structural forecasts on a regular basis, they need to be supplemented by in-depth forecasts for countries which are at a particularly high risk of breakdown. Note that this approach is similar to earthquake warnings. The structural approach is used there to identify the regions of the world with a particularly high structural risk. To assess the high-risk regions the dynamics of changing earthquake risks, seismologists resort to dynamic analysis that assesses the probability of a major earthquake over time.
- The dynamic analysis of countries which are at a considerable risk needs to be supplemented by careful analyses what key decision makers want, what their power is

and what policy options are at stake. We have suggested that such information is used in game theoretic models from which we can derive forecasts of what a collective of actor will decide. It is certainly possible that other models of social interactions will be used for the purpose to derive forecasts. We have, up to now, however, not seen such applications although they are easier to apply than more standard forecasting technologies which require vast amounts of often not existing statistical data.

- Once the international development community receives the forecasts of the research community or its forecasting units, it needs to discuss carefully with its academic partner what these forecasts imply. Unfortunately, most current forecasts do not take it into account how varying policy prerogatives affect the risk of state failure. The entire prediction business is therefore conducted in complete isolation from the policy world. We believe that this academic isolationism, to which both sides, the academic one and the policy one, contribute, needs to change if we ever want to truly accept the social sciences as a useful collection of disciplines that is able to deal with urgent human problems and ways in which they can be addressed.
- As a next step, in order to make use of its “power”, the international community should seek consent on processes and means for taking preventive action. It is beyond the scope of this study to discuss adequate conflict prevention tools. However, without taking early action, recommendations based on sound and systematic early warning analysis will clearly be without any effect.
- All in all, we believe that it is mandatory for the development policy community to take the challenge of tipping points and their prediction seriously and to create a “prediction culture”, through which the usage of prediction tools becomes a routine task in model testing. Moreover, if agencies are able to intervene in a timely fashion and to prevent the worst, a further humanitarian disaster might be avoided. We believe that a forecasting culture can only be reached if well trained social scientists are put in charge of early warning units and if they are in a constant dialogue with policy makers. This concerns not only developed countries where preventive action is organised, but also developing countries where risks of social tipping points emerge. In both worlds, the capacity to collect and to process data should be strengthened. Obviously, this is especially demanding in fragile and authoritarian states where social mistrust, a lack of political transparency and a lack of infrastructure hamper professional attempts to gather reliable and representative information. Unaddressed, the quality of sources will be put into question and the whole business of tipping point forecasting will be delegitimized.

5.3 Avenues for further research

Obviously, the social sciences are an ever-evolving set of academic disciplines in which the enthusiasm for prediction is not constant and in which the current enthusiasm about forecasting will experience a certain backlash. We nevertheless expect that prediction will become much more common and that assessments of the ex ante forecasting capacity of an empirical model will become a routine affair. One way forward for the prediction of social tipping points will be that the three approaches presented in this report will be used together. It is also possible to use the qualitative assessments of experts about a possible scenario as priors for the Bayesian analysis of the tipping point risk in dynamic and structural models. Furthermore, the relative accuracy of competing models should be assessed in the way that the model performances were compared in Thomson et al. (2006) and O’Brien (2010). As much as early warning of tipping point processes can only be im-

proved through the constant dialogue with policy makers, as much it is necessary to continuously evaluate the underlying theoretical and empirical models.

Bibliography

- Achen, C. (2006): Evaluating political decision making models, in: R. Thomas et al. (eds.), *The European Union decides: the empirical relevance of policy making models*, Cambridge: Cambridge University Press, 86–123
- Arrow, K. J. et al. (2008): The promise of prediction markets, in: *Science* 320 (5878), 877–878
- Bailer, S. / G. Schneider (2006): Nash or Schelling: legislative bargaining with and without domestic constraints, in: R. Thomas et al. (eds.), *The European Union decides: the empirical relevance of policy making models*, Cambridge: Cambridge University Press, 153–177
- Baskin, M. (2003): Post-conflict administration and reconstruction, in: *International Affairs* 79 (1), 161–170
- Bates, R. H. (2008): When things fall apart: state failure in late-century Africa, Cambridge: Cambridge University Press
- Batt, J. / D. Lynch (2004): What is a failing state, and when is it a security threat?, Paris: European Union Institute for Security Studies (ISS Analysis 99)
- Beck, N. / G. King / L. Zeng (2000): Improving quantitative studies of international conflict: a conjecture, in: *The American Political Science Review* 94 (1), 21–35
- Berg, J. E. / F. D. Nelson / T. A. Rietz (2008): Prediction market accuracy in the long run, in: *International Journal of Forecasting* 24 (2), 285–298
- Bliemel, F. (1973): Theil's forecast accuracy coefficient: a clarification, in: *Journal of Marketing Research* 10 (4), 444–446
- Bosler, N. / G. Schneider (2011): The oracle or the crowd?: experts versus the stock market in forecasting ceasefire success in the Levant, Montréal: International Studies Association (ISA Convention Paper)
- Brancati, D. (2007): Political aftershocks: the impact of earthquakes on intrastate conflict, in: *Journal of Conflict Resolution* 51 (5), 715–743
- Brandt, P. T. / J. R. Freeman / P. A. Schrodt (2011): Real time: time series forecasting of inter- and intrastate political conflict, mimeo
- Brown, M. E. / R. N. Rosecrane (eds.) (1999): *The costs of conflict: prevention and cure in the global arena*, New York, NY: Carnegie Corporation of New York
- Brunnschweiler, C. N. (2008): Cursing the blessings?: natural resource abundance, institutions and economic growth, in: *World Development* 36 (3), 399–419
- Brunnschweiler, C. N. / E. H. Bulte (2008): Linking natural resources to slow growth and more conflict, in: *Science* 320 (5876), 616–617
- Bueno de Mesquita, B. (2002): *Predicting politics*, Columbus, Ohio: Ohio State University Press
- (2004): Decision-making models, rigor and new puzzles, in: *European Union Politics* 5 (1), 125–138
- (2009): *The predictioneer's game: using the logic of brazen self-interest to see and shape the future*, New York, NY: Random House
- (2011): A new model for predicting policy choices: preliminary tests, mimeo
- Bueno de Mesquita, B. / D. Newman / A. Rabushka (1985): *Forecasting political events: the future of Hong Kong*, New Haven, Conn.: Yale University Press
- Burke, M. B. et al. (2009): Warming increases the risk of civil war in Africa, in: *Proceedings of the National Academy of Science* 106 (49), 20670–20674
- Buhaug, H. (2010): Climate not to blame for African civil wars, in: *Proceedings of the National Academy of Science* 107 (38), 16477–16482
- Bussmann, M. / G. Schneider (2007): When globalization discontent turns violent: foreign economic liberalization and internal war, in: *International Studies Quarterly* 51 (1), 79–97
- Carment, D. (2003): Assessing state failure: implications for theory and policy, in: *Third World Quarterly* 24 (3), 407–427
- Chesterman, S. / M. Ignatieff / R. C. Thakur (eds.) (2005): *Making states work: state failure and the crisis of governance*, Tokyo: United Nations University Press

- Collier, P. / A. Hoeffler (2004): Greed and grievance in civil wars, in: *Oxford Economic Papers* 56 (4), 563–595
- Collier, P. / A. Hoeffler / D. Rohner (2009): Beyond greed and grievance: feasibility and civil war, in: *Oxford Economic Papers* 61, 1–27
- Choucri, N. / T. W. Robinson (1978): *Forecasting in international relations: theory, methods, problems, prospects*, San Francisco, Calif.: Freeman
- Esteban, J. / D. Ray (1999): Conflict and distribution, in: *Journal of Economic Theory* 87 (2), 379–415
- (2008): Polarization, fractionalization and conflict, in: *Journal of Peace Research* 45 (2), 163–18
- Esteban, J. / G. Schneider (2008): Polarization and conflict: theoretical and empirical issues, in: *Journal of Peace Research* 45 (2), 131–141
- Fabra Mata, J. / S. Ziaja (2009): *User's guide on measuring fragility*, Bonn, Oslo: DIE, UNDP
- Faust, J. / S. Neubert (eds.) (2010): *Wirksamere Entwicklungspolitik: Befunde, Reformen, Instrumente*, Baden-Baden: Nomos
- Fearon, J. D. (2008): Economic development, insurgency, and civil war, in: E. Helpmann (ed.), *Institutions and economic performance*, Cambridge, Mass.: Harvard University Press, 292–328
- Fearon, J. D. / D. Laitin (2003): Ethnicity, insurgency, and civil war, in: *The American Political Science Review* 97 (1), 75–90
- Feder, S. A. (1995): Factions and policon: new ways to analyze politics, in: H. B. Westerfield (ed.), *Inside CIA's private world: declassified articles from the agency's internal journal: 1955–1992*, New Haven, Conn.: Yale University Press, 222–274
- (2002): Forecasting for policy making in the post-cold war period, in: *Annual Review of Political Science* 5, 111–125
- Feil, S. R. (1998): *Preventing genocide: how the early use of force might have succeeded in Rwanda*, New York, NY: Carnegie Commission on Preventing Deadly Conflict
- Fein, H. (1992): Dangerous states and endangered people: implications of life integrity violations analysis, in: K. Rupesinghe / M. Kuroda (eds.), *Early warning and conflict resolution*, New York, NY: St. Martin's, 40–61
- Fund for Peace (2010): Failed states index scores 2010; online: http://www.fundforpeace.org/web/index.php?option=com_content&task=view&id=452&Itemid=900 (accessed 10 Dec. 2010)
- Goldstein, J. (1992): A conflict-cooperation scale for WEIS events data, in: *Journal of Conflict Resolution* 36 (2), 369–385
- Goldstone, J. A. et al. (2000): State failure task force report: phase III findings; online: <http://globalpolicy.gmu.edu/pitf/SFTF%20Phase%20III%20Report%20Final.pdf> (accessed 11 Jan. 2011)
- (2010): A global model for forecasting political instability, in: *American Journal of Political Science* 54 (1), 190–208
- Granovetter, M. (1978): Threshold models of collective behavior, in: *American Journal of Sociology* 83 (6), 1420–1443
- Grodzins, M. M. (1958): *The metropolitan area as a racial problem*, Pittsburgh, PA: University of Pittsburgh Press
- Gromes, T. (2009): *Zwischen Zumutung und Versprechen: Die Demokratie in Makedonien*, Frankfurt am Main: Hessische Stiftung Friedens- und Konfliktforschung (HSFK Report 8/2009)
- Gurr, T. R. (1998): A risk assessment model of ethno-political rebellion, in: J. L. Davies / T. R. Gurr (eds.), *Preventive measures: building risk assessment and crisis early warning systems*, Lanham: Rowman & Littlefield, 15–26
- Gurr, T. R. / W. H. Moore (1997): Ethno-political rebellion: a cross-sectional analysis of the 1980s with risk assessments for the 1990s, in: *American Journal of Political Science* 41, 1079–1103
- Gurr, T. R. / M. G. Marshall / D. Khosla (2001): *Peace and conflict 2001: a global survey of armed conflicts, self-determination movements, and democracy*, College Park, Md.: University of Maryland Press
- Gurr, T. R. / M. Woodward / M. G. Marshall (2005): Forecasting instability: are ethnic wars and Muslim countries different?; online: <http://globalpolicy.gmu.edu/pitf/pitfp5.htm> (accessed 11 Jan. 2011)

- Harff, B. (1998): Early warning of humanitarian crises: sequential models and the role of accelerators, in: J. L. Davies / T. R. Gurr (eds.), *Preventive measures: building risk assessment and crisis early warning systems*, Lanham: Rowman & Littlefield, 70–78
- (2003): No lessons learned from the Holocaust?: assessing risks of genocide and political mass murder since 1955, in: *The American Political Science Review* 97 (1), 57–73
- Harff, B. / T. R. Gurr (1998): Systematic early warning of humanitarian emergencies, in: *Journal of Peace Research* 35 (5), 551–579
- Hough, S. (2010): *Predicting the unpredictable*, Princeton, NJ: Princeton University Press
- Ignatieff, M. (2004): State failure and nation-building, in: J. L. Holzgrefe / R. O. Keohane (eds.), *Humanitarian intervention: ethical, legal, and political dilemmas*, Cambridge: Cambridge University Press, 299–321
- King, G. / L. Zeng (2001): Improving forecasts of state failure, in: *World Politics* 53 (4), 623–658
- Kötter, M. (2007): *Der Governance-Raum als Analysefaktor: Am Beispiel von Räumen begrenzter Staatlichkeit*, Berlin: Deutsche Forschungsgesellschaft (SFB Governance Working Paper 3)
- Krasner, S. D. (1999): *Sovereignty: organized hypocrisy*, Princeton, NJ: Princeton University Press
- Kritz, N. J. (1996): The rule of law in the postconflict phase: building a stable peace, in: C. A. Crocker / F. O. Hampson / P. R. Aall (eds.), *Managing global chaos: sources of and responses to international conflict*, Washington, DC: United States Institute of Peace Press, 587–606
- Kronenberger, V. / J. Wouters (eds.) (2004): *The European Union and conflict prevention: policy and legal aspects*, The Hague: Asser Press
- ICG (*International Crisis Group*) (2010): Report 2010: review 2009: plans for 2010; online: <http://www.crisisgroup.org/en/about/~media/Files/misc/Annual%20Report%202010.ashx> (accessed 10 Dec. 2010)
- Lenton, T. M. et al. (2008): Tipping elements in the Earth's climate system, in: *Proceedings of the National Academy of Sciences of the United States of America* 105 (6), 1786–1793
- Linz, J. J. / A. Stepan (1996): Stateness, nationalism, and democratization, in: J. J. Linz / A. Stepan (eds.) *Problems of democratic transitions and consolidation*, Baltimore, Md.: Johns Hopkins University Press, 16–37
- Lobe, A. (2011): Die Wissenschaft vom stabilen Orient, in: *Frankfurter Allgemeine Zeitung* 24 Mar. 2011; online: <http://www.faz.net/s/Rub5C2BFD49230B472BA96E0B2CF9FAB88C/Doc~E430DC32F39C54F1AAE092E32E6C01DFA~ATpl~Ecommon~Scontent.html> (accessed 28 Mar. 2011)
- Lund, M. S. (2005): Greed and grievance diverted: how Macedonia avoided civil war 1990-2001, in: P. Collier / N. Sambanis (eds.), *Understanding civil war: evidence and analysis: Europe, central Asia, and other regions*, Washington, DC: The World Bank, 231–257
- Malberg, H. (2002): *Meteorologie und Klimatologie: Eine Einführung*, Berlin: Springer
- Meadows, D. H. et al. (1972): *The limits to growth*, New York, NY: Universe Books
- Merkel, W. et al. (2003): *Defekte Demokratie: Theorie*, Opladen: Leske + Budrich
- Moore, W. H. / T. R. Gurr (1998): Assessing risks of ethnorebellion in the year 2000: three empirical approaches, in: S. Schmeidl / H. Adelman (eds.), *Early warning and early response*, New York, NY: Columbia University Press; online: <http://garnet.acns.fsu.edu/~whmoore/research/Moore&Gurr98.pdf> (accessed 11 Jan. 2011)
- Nel, P. / M. Righarts (2008): Natural disasters and the risk of violent civil conflict, in: *International Studies Quarterly* 52 (1), 159–185
- Niño Pérez, J. (2004): Conflict indicators developed by the commission: the check-list for root causes of conflict: early warning indicators, in: V. Kronenberger / J. Wouters (eds.), *The European Union and conflict prevention: policy and legal aspects*, The Hague: Asser Press, 3–20
- O'Brien, S. P. (2002): Anticipating the good, the bad, and the ugly, in: *Journal of Conflict Resolution* 46 (6), 791–811
- (2010): Crisis early warning and decision support: contemporary approaches and thoughts on future research, in: *International Studies Review* 12 (1), 87–104

- OECD (Organisation for Economic Cooperation and Development) (2009): Preventing violence, war, and state collapse: the future of conflict early warning and response; online: http://www.oecd.org/document/41/0,3746,en_2649_33693550_42233001_1_1_1_1,00.html (accessed 10 Dec. 2010)
- (2010): Resource flows to fragile and conflict-affected states 2010; online: http://www.oecd.org/document/13/0,3343,en_2649_33693550_45789965_1_1_1_1,00.html (accessed 10 Dec. 2010)
- Ottaway, M. (2003): Promoting democracy after conflict: the difficult choices, in: *International Studies Perspectives* 4 (3), 314–322
- Østby, G. (2008): Polarization, horizontal inequalities, and violent civil conflict, in: *Journal of Peace Research* 45 (2), 143–162
- Pevehouse, J. C. / J. S. Goldstein (1999): Serbian compliance or defiance in Kosovo?: statistical analysis and real-time predictions, in: *Journal of Conflict Resolution* 43 (4), 538–546
- Poe, S. C. / N. Rost / S. C. Carey (2006): Assessing risk and opportunity in conflict studies: a human rights analysis, in: *Journal of Conflict Resolution* 50 (4), 484–507
- Risse, T. (2005): Governance in Räumen begrenzter Staatlichkeit, in: *Internationale Politik* 60 (9), 6–12
- (2007): Regieren in Räumen begrenzter Staatlichkeit: Zur Reisefähigkeit des Governance-Konzeptes, Berlin: Deutsche Forschungsgesellschaft (SFB Governance Working Paper 5)
- Rost, N. / G. Schneider / J. Kleibl (2009): A global risk assessment model for civil wars, in: *Social Science Research* 38 (4), 921–933
- Rotberg, R. I. (ed.) (2004): When states fail: causes and consequences, Princeton, NJ: Princeton University Press
- Ruoff, G. / G. Schneider (2006): Segregation in the classroom: an empirical test of the Schelling Model, in: *Rationality and Society* 18 (1), 95–117
- Rustad, S. et al. (2011): All conflict is local: modeling sub-national variation in civil conflict risk, mimeo
- Schaffer, L. M. / G. Schneider (2005): Die Prognosegüte von Wahlbörsen und Meinungsumfragen zur Bundestagswahl 2005, in: *Politische Vierteljahresschrift* 46 (4), 674–681
- Scheffer, M. et al. (2009): Early-warning signals for critical transitions, in: *Nature* 461 (3), 53–59
- (2001): Catastrophic shifts in ecosystems, in: *Nature* 413 (6), 591–596
- Schelling, T. C. (1960) *Strategy of conflict*, Cambridge, Mass.: Harvard University Press
- (1971): Dynamic models of segregation, in: *Journal of Mathematical Sociology* 1, 143–86
- (1972): The process of residential segregation: neighborhood tipping, in: A. Pascal (ed.), *Racial discrimination in economic life*, Lexington, Mass.: Lexington Books, 157–184
- (1978): *Micromotives and macrobehavior*, New York, NY: Norton
- Schmeidl, S. / J. C. Jenkins (1998a): Early warning indicators of forced migration, in: J. L. Davies / T. R. Gurr (eds.), *Preventive measures: building risk assessment and crisis early warning systems*, Lanham: Rowman & Littlefield, 56–69
- (1998b): The early warning of humanitarian disasters: problems in building an early warning system, in: *International Migration Review* 32 (2), 471–485
- Schneckener, U. (2005): Fragile Staatlichkeit als globales Sicherheitsrisiko, in: *Aus Politik und Zeitgeschichte* 28/29, 26–31
- Schneider, G. (s. a.): Banking on the broker: forecasting conflict in the Levant with financial data, in: F. Wayman / P. Williamson / B. Bueno de Mesquita (eds.), *Illuminating the shadow of the future: scientific prediction and the human condition*, Ann Arbor, Mich.: University of Michigan Press, forthcoming
- Schneider, G. / V. E. Troeger (2006): War and the world economy, in: *Journal of Conflict Resolution* 50 (5), 623–645
- Schneider, G. / D. Finke / S. Bailer (2010): Bargaining power in the European Union: an evaluation of competing game-theoretic model, in: *Political Studies* 58 (1), 85–103
- Schneider, G. / N. P. Gleditsch / S. Carey (2010): Exploring the past, anticipating the future, in: *International Studies Review* 12 (1), 1–7
- (2011): Forecasting in international relations: one quest, three approaches, mimeo

- Schrodt, P. A. / D. J. Gerner* (2000): Using cluster analysis to derive early warning indicators for political change in the Middle East: 1979-1996, in *The American Political Science Review* 94 (4), 803–818
- Schuppert, G. F.* (ed.) (2008): *Governance als Prozess*, Baden-Baden: Nomos
- Taleb, N. N.* (2007): *The black swan: the impact of The highly improbable*, London: Penguin Books
- Tellis, A. J. / T. S. Szayna / J. A. Winnefeld* (1997): *Anticipating ethnic conflict*, Santa Monica, Calif.: Rand
- Tetlock, P. E.* (2005): *Expert political judgement*, Princeton, NJ: Princeton University Press
- (2009) Reading tarot on K Street; online: <http://nationalinterest.org/bookreview/reading-tarot-on-k-street-3220?page=3> (accessed 10 Dec. 2010)
- Theil, H.* (1966): *Applied economic forecasting*, Chicago, Ill.: Rand McNally
- Thomson, R. et al.* (2006): *The European Union decides*, Cambridge: Cambridge University Press
- Urdal, H.* (2008): Population, resources and violent conflict: a sub-national study of India: 1956-2002, in: *Journal of Conflict Resolution* 52 (4), 590–617
- Ward, M. D. / K. S. Gleditsch* (2002): Location, location, location: an MCMC approach to modeling the spatial context of war and peace, in: *Political Analysis* 10 (3), 244–260
- Ward, M. D. / R. M. Siverson / X. Cao* (2007): Disputes, democracies, and dependencies: a re-examination of the Kantian peace, in: *American Journal of Political Science* 51 (3), 583–601
- Ward, M. D. / B. D. Greenhill / K. M. Bakke* (2010): Perils of policy by P-Value: predicting civil conflicts, in: *Journal of Peace Research* 47 (4), 363–375
- WBGU (German Advisory Council on Global Change)* (2008): *Climate change as a security risk*, London: Earthscan
- Weidmann, N. B. / M. D. Ward* (2010): Predicting conflict in space and time, in: *Journal of Conflict Resolution* 55 (6), 883–901
- Wildavsky, A.* (1979): *Speaking truth to power: the art and craft of policy analysis*, Boston, Mass.: Little Brown & Co.
- Wolfers, J. / E. W. Zitzewitz* (2004): Prediction markets, in: *Journal of Economic Perspectives* 18, 107–126
- World Bank* (2009): *Engaging with fragile states*; online: <http://www.worldbank.org/ieg/licus/download.html> (accessed 10 Dec. 2010)
- Zartman, I. W.* (2001): Preventing deadly conflict, in: *Security Dialogue* 32 (2), 137–154

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