Forecasting in International Relations: One Quest, Three Approaches*

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As a discipline matures, prediction becomes one of its standard and routine practices. The field of international relations is no exception. The growing attention to forecasting within academic research accompanies increasing expectations by the policy community that international relations research should be able to provide early warning of conflict and other human disasters and should therefore actively be engaged in forecasting exercises.[1] Many international relations scholars nevertheless continue to see prediction as an inferior task in comparison to explanation and buy into the lamentation that forecasting is impossible[2]. Even a pioneer in forecasting like Oskar Morgenstern could not always resist such impulses: "Economic prognosis is….impossible for objective reasons" (Morgenstern, 1928:108, our translation).

A growing number of sophisticated forecasts shows, by contrast, that the discipline has come of age and increasingly includes ex-post and ex-ante predictions in the presentation of the research results. A particularly encouraging sign is the multitude of approaches that scholars have developed over recent years to improve the predictive capacity of their models and to offer early warning schemes to the policy community (Schneider, Gleditsch, and Carey, 2010). These achievements acknowledge that forecasting international trends and events is no panacea. Tragic events such as genocides, massive terrorist attacks, and large-scale wars still occur, but fortunately quite rarely (Mack, 2007). However, it is exactly this rarity that makes such events so hard to anticipate. Prediction is at least as difficult for the social scientist as for the seismologist who tries to forecast the most devastating earthquakes. The two share the ambition to identify potential events among a class of similarly anticipated instances that carry the seeds of the extreme.[3]

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[1] Governmental organizations initiate and support an increasing number of forecasting projects, such as the Political Instability Task Force (Goldstone et al., 2010), funded by the US Central Intelligence Agency.

[2] See Bechtel and Leuffen (2010) and Schneider, Gleditsch, and Carey (2010) for additional statements. The skepticism against systematic forecasts often goes hand in hand with references to Bohr´s famous quip, which is, in the repetition, quite trite. "Prediction is very difficult, especially about the future". However, the Danish Nobel laureate stated these doubts, according to one account, after a presentation of quantum physics and in response to a very general question about the future of the world. The presentation which also referred to Heisenberg´s uncertainty principle suggested that knowing the current state of affairs is also challenging and thus forecasting in the same vain nearly impossible The statement or versions of it have also been attributed to other people, including Mark Twain and Danish writer Robert Storm Petersen *(The Economist*,2007).

[3] Unsurprisingly, seismology also has its sceptics. According to Hough (2010: 222), "…given the state of earthquake science at the present time, earthquakes are unpredictable." Nevertheless, she does not go as far as those social scientists who believe that forecasting important trends and events is a vain vision.

It is not very helpful for the attempts to forecast structural breaks and sudden changes that the prediction is frequently based on data that change only slowly over time and therefore are only suitable for the prediction of minor changes. Furthermore, scientific predictions are only possible in fields where the forecasters can rely on prior knowledge and accumulated evidence in the form of systematically collected data or the insights of experts who possess privileged knowledge about an otherwise impenetrable decision making process.

Fortunately, the information basis is improving in many areas. Especially the rise of the internet has provided the international forecasting community with a wealth of data that it does not yet use sufficiently (Brandt, Freeman, and Schrodt, 2011). The most important variables that feed a forecasting model and that provide the crucial information do not necessarily have to be the theoretically most fanciful concepts. On the contrary, Ward, Greenhill, and Bakke (2010) show in their evaluation of two prominent empirical models of civil war onset that the addition of explanatory factors, which create maximum media attention, does not improve the predictive accuracy of the models. This should alert the research community to the need to assess whether their theoretically favoured explanations really contribute to our understanding of why certain events have occurred and to the accurate prediction of a particular event in the future.

In this introduction we consider the advantages and disadvantages of three different approaches that grapple with these challenges. First, we discuss the merits of the structural approach, which tries 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 characteristics of the unit at present. This traditional approach has recently seen the import of classification techniques such as neural network algorithms (Beck, King and Zeng, 2000; Rost, Schneider, and Kleibl, 2009) and of cutting-edge econometric tools (Ward and Gleditsch, 2002). Such innovations have improved the predictive accuracy of conventional structural models. But the high level of temporal or spatial aggregation is a major limitation of this approach, especially as the covariates often only change slowly.

To circumvent some of the problems of the structural approach, scholars frequently resort to time-series designs, using shorter time intervals. There are numerous attempts to predict the further evolution of conflict within a particular conflict area like Kosovo (e.g. Pevehouse and Goldstein, 1999) or the Levant (e.g. Schrodt and Gerner, 2000; Schneider, 2012). 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 third and final approach, pioneered by Bueno de Mesquita and his co-authors (e.g., Bueno de Mesquita, Newman, and Rabushka 1985; Bueno de Mesquita, 2011; see also Bueno de Mesquita, 2002, 2009 for summaries), is game-theoretic. The general idea of this initially decision-theoretic framework is to use detailed information from area experts as the empirical basis. The forecaster then employs these data as the input for strategic models that calculate predictions about possible outcomes in political contests. The approach is 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, and Bailer, 2010) and elsewhere (Bueno de Mesquita, 2002, 2009). Rational-choice forecasting models are generally attributed with very high levels of predictive accuracy, as evaluations of classified predictions show (see e.g., Feder, 1995 as well as the survey by Feder, 2002). The main limitation of this approach so far is the limited ability to predict how a process unfolds over time (for a partial exception see Bueno de Mesquita, 2011). .

Obviously 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. 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. In the following, we discuss the pros and cons of the three approaches in greater detail and provide an overview of the innovations in the three articles in this special issue.

Information, events and the ability to predict

In the social sciences and elsewhere, forecasting boils down to the evaluation of different scenarios that one can obtain from running competing models. The academic goal is the identification of the out-of-sample prediction 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. 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. Nevertheless, the predictions do not necessarily need to make much sense theoretically. What ultimately matters is the accuracy of the forecast.

A number of indicators help the researcher to assess the success of a particular approach in forecasting the real outcome and to compare competing models systematically. The list of criteria ranges from the number of point predictions over the mean square error to Theil´s (1966) measure of forecasting accuracy.[4] There is, in our view, no universal statistic that is preferable in all contexts. Achen (2006) shows that the model that delivers a low mean square error is not necessarily the one which provides the largest number of correct point predictions.

Explanation and prediction go together. However, Hempel´s (1963) equivalence principle, according to which these two scientific tasks are identical, no longer plays a prominent role in the philosophy of science. All forecasters hope nevertheless that a scientific model offers an improvement over a completely atheoretical model based on a rule of thumb such as "Tomorrow's weather will be like today's". However, there is no guarantee that a scientific forecast that is based on a more convincing causal mechanism will triumph over an atheoretical model. To stay with the weather metaphor, some models might be successful in forecasting thunderstorms, but might dismally fail in the prognosis of sunshine. Such differences also beset political science forecasting models. The asymmetric version of the Nash Bargaining Solution (NBS) that Schneider, Finke, and Bailer (2010) use for the prediction of EU decision-making processes provides fewer point prediction than NBS models that do not correct for the power of the actors. While the asymmetric version predicts extreme cases at the corners of the bargaining zone, the simple NBS and related models more often expect some sort of compromise close to the middle of this interval. This also means that the mean square error or a related statistic biases the results in favour of the compromise predictions (cf. Bueno de Mesquita, 2004).

No forecasting technique or model is therefore superior in all contexts. However, we suggest in the following which approach might be adequate in a particular situation. In our view, the key problems of forecasting political events are twofold: First, prediction crucially depends on the reliability of the information used for the forecast. Second, a model appropriate for an expected event that represents a structural break might be less suitable for a situation where a routine change is anticipated. We will discuss these challenges in turn.

[4] Brandt, Freeman, and Schrodt (2011) convincingly argue that a standard error should be provided with any point prediction. We agree as far as a probabilistic rather than a deterministic model is concerned.

The information problem boils down to a contention that rigorously developed expectations are as good as the data that the researcher feeds into the empirical model. This often leads to ex-post facto expressions of consternation that a traumatizing event could have been prevented or a certain beneficial development could have materialized because the relevant information was allegedly present at the critical juncture. For instance, Feil (1998: 3) remarks 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".

The requirement of a sound empirical footing of any forecast is particularly relevant for the analysis of key social or economic trends that are influenced by a multitude of arcane decisions in various settings. As no reliable micro-level information is obtainable for most decision-making processes, political forecasting often only relies on rough macro-level indicators that do not vary much over time. Unsurprisingly, models of developments that are heavily shaped by political decisions but resort to this limited empirical basis often only provide shaky forecasts. Many attempts to forecast the fate of the globe in the long term, such as the best-selling *The Limits to Growth* (Meadows et al., 1972), have suffered this fate.

However, macro-level information can be useful in attempts to predict certain outcomes in the medium term. This is the area were the structural approach seems particularly relevant. Forecasting models in this tradition of research assume that one is able to assess which political unit – or collection thereof, like a pair of states – is at a particularly high risk of experiencing a certain outcome, be it interstate war (Beck, King, Zeng, 2000), civil war (Rost, Schneider, and Kleibl, 2009; Ward, Greenhill, and Bakke, 2010), human rights violations (Poe, Rost, and Carey, 2007), or terrorism (Clauset, Young, and Gleditsch, 2007). The typical research design here is cross-sectional or longitudinal. The main problem with this approach is that it often does not predict the outcome of interest very well. According to Ward, Siverson, and Cao (2007), a well-know liberal model of conflict – the Kantian theory of peace as propagated by Russett and Oneal (2001) – predicts no single case of interstate conflict between 1885 and 1992. The empirical power of the conventional model is therefore limited to the prediction of the more common (and therefore in a sense "uninteresting") event, i.e. peace. If we change the research design and move to a neural network perspective (cf. Beck, King, and Zeng, 2000), the statistical model might be able to predict also positive occurrences of conflict. However, the structural approach cannot really overcome the problem that it relies on macro-indicators to predict relatively rare events that often only occur regionally or locally.

The article by Rustad et al. (2011) breaks new ground in using the structural approach to predict conflict through an innovative combination of national- and regional-level data. Their analysis builds a national model using country-specific factors and time trends, including regime type, GDP per capita, and country population. In addition to these relatively time-invariant indicators, the model incorporates factors that could act as possible triggers for conflict: change in political leadership, severity of natural disasters, irregular regime changes, and ethno-political exclusion. To estimate the parameters, the model uses data from 1951 to 2004. These parameter estimates are then used to calculate the probability of civil war risk in Asian countries using the most recent data on the independent variables. In the second step, Rustad et al. (2011) construct a sub-national index of risk for first-order administrative entities, such as provinces and districts, based on their relative population size, socioeconomic status, ethno-political exclusion, as well as conflict history, distance from the capital and neighboring conflicts. The scores of the index, as well as the relative weight of the causal factors, can be adapted by policymakers to include new information. These local risk scores are then combined with the national ones obtained from the first part of the analysis and the

results are visualised via maps. The examples of Nepal and the Philippines highlight provinces that are expected to be particularly conflict-prone.

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- or medium-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 do often not exist for those countries in which public institutions have failed to an extent that the usage of violence seems imminent. Second, some structural indicators are inadequate for the forecasting of short- or medium-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 her observation of escalatory tendencies this week, even using indicators disaggregated to the level of the month does not make sense.

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. Brandt, Freeman, and Schrodt (2011) address some of these issues in their contribution to this symposium. They develop a new forecasting tool that addresses some of the shortcomings of structural models and test it by producing event data-based forecasts for the conflict between Israelis and Palestinians for 2010. To minimize the problem of highly aggregate and possibly missing or vague information, Brandt, Freeman, and Schrodt incorporate expert judgement in the form of Bayesian priors, based on existing theoretical and empirical work on conflict dynamics. They use two advanced Bayesian estimation techniques, Bayesian vector autoregression (BVAR) and Markov-switching Bayesian vector autoregression (MS-BVAR) models, for the development of their forecasts. These models allow the inclusion of phase shifts in the behavior of the conflict actors. Their data are generated by the automated coding software TABARI, which allows for the collection of relevant information in real time. Using the CAMEO coding system, Brandt, Freeman, and Schrodt provide weekly forecasts for the conflict between Israelis and Palestinians in real-time.

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 and 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, Nelson, and Rietz, 2008; Schaffer and 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.

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.

This leads to the second challenge that attempts to forecast international events have to master – the possibility of dramatic 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 data set 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, Stokman, Achen, and König, 2006). The new model developed by Bueno de Mesquita adds additional complexity to the original framework devised in Bueno de Mesquita, Newman and 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 times series models presented in Brandt, Freeman, and Schrodt (2011). Empirically, the new forecasting models of Bueno de Mesquita performs better than the models presented in Thomson, Stokman, Achen and König (2006), but slightly worse than one of the adaptations of the Nash Bargaining Solutions introduced by Schneider, Finke, and Bailer (2010). Although the data base used for the production of the models and the assessment criteria differ slightly, it remains to be seen how Bueno de Mesquita's new model will fare in other decision-making contexts in comparison to standard decision and game-theoretic models.

Conclusion

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 forecasts 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 see 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. 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.

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