



## Integrating prediction market and Delphi methodology into a foresight support system – Insights from an online game



Tobias Prokesch <sup>a,\*</sup>, Heiko A. von der Gracht <sup>b,1</sup>, Holger Wohlenberg <sup>c,2</sup>

<sup>a</sup> EBS Business School, Gustav-Stresemann-Ring 3, 65189 Wiesbaden, Germany

<sup>b</sup> Friedrich-Alexander-University (FAU) Erlangen-Nuremberg, Lange Gasse 20, 90403 Nuremberg, Germany

<sup>c</sup> Deutsche Börse AG, Mergenthalerallee 61, 65760 Eschborn, Germany

### ARTICLE INFO

#### Article history:

Received 14 March 2013

Received in revised form 17 January 2014

Accepted 3 February 2014

Available online 13 March 2014

#### Keywords:

Forecasting

Prediction market

Information integration

Delphi method

Decision and foresight support system

### ABSTRACT

In this paper, we introduce a novel approach, an electronic combination of a prediction market and Delphi methodology, to create a foresight support system (FSS). While the Delphi method has been a widely accepted foresight technique, prediction markets have been a very recent innovation to the existing decision and foresight support systems. Though, traditional prediction markets have been quite successful recently, our extension to the traditional prediction market methodology allows us to extract more valuable market information than any other prediction market since our approach provides not only a market forecast but also delivers an entire forecast distribution. The forecast distribution is generated by the aggregation of another unique characteristic of the suggested market structure namely that financial market professionals have to submit an interval forecast rather than point forecast. Based on our analysis, we demonstrate that our market is weak-form efficient and hence contains all publicly available information. In terms of forecasting accuracy, we conclude that the precision of our market improved over time and overall outperformed its benchmark.

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### 1. Introduction

One of the most critical challenges for modern firms is to effectively use internal information. This challenge applies especially to forecasting tasks, which are frequently described as being both “art and science” [1]. While the term “art” is attributable to the various forms of managerial judgment, the term “science” refers to methods of empirical social research, including statistical methods, to analyze historical data. Unfortunately, organizational forecasting is often hindered since an appropriate data-based approach is neither available nor applicable [2]. In addition, the costs associated with data collection, either through customer surveys or external data

providers, create another barrier. As a consequence, many organizations rely on internal informants, such as research analysts, business managers or sales representatives for the development of forecasts. The literature refers to this type of forecasting as “institutional forecasting” [3]. In order to enhance institutional forecasting, Van Bruggen et al. [3] proposed that firms should create prediction markets, as IT-based forecasting or foresight platforms that allow informants to exchange information [4].

The primary purpose of prediction markets, sometimes referred to as information markets, idea futures, or event futures, is to use the information content inherent in market values to predict specific future events. Hanson [5] introduced the idea of conditional prediction markets to support his idea of decision markets. According to the researcher, decision markets serve the same purpose as prediction markets. Both use the information content of market values to come to a decision. Considering this definition, prediction markets or decision markets can be understood as decision

\* Corresponding author. Tel.: +49 611 7102 1291; fax: +49 7102 10 1291.

E-mail addresses: tobias.prokesch@ebs.edu (T. Prokesch), heikovdg@gmx.de (H.A. von der Gracht), holger.wohlenberg@deutsche-boerse.com (H. Wohlenberg).

<sup>1</sup> Tel.: +49 911 5302 444; fax: +49 911 5302 460.

<sup>2</sup> Tel.: +49 69 2 11 1 23 00; fax: +49 692 1161 23 00.

support systems. Furthermore, with their future-orientation prediction markets can be considered foresight support system (FSS), which allows experts and stakeholders to collaborate over an entire foresight process and thereby supports in reaching decisions oriented towards the future [6]. While the term FSS first emerged in 2000 [7] it has only been sporadically used since then, for instance at conferences [8]. The research of Bañuls and Salmeron [9] in 2011 marks the beginning of the systematic study on the methodology of FSS as an emerging separate field of research. In the past, multi-criteria decision making (MCDM) has been widely adapted for technology foresight [10]. Ensuing from MCDM, researchers extended this policy making process by combining multi-criteria support procedures with the Delphi method [11,12] to create a foresight support system that combines the benefits of both methods and obtain synergetic effects. As early as 2004 Salo and Gustafsson [13] identified the potential of the Internet to advance foresight processes since the Internet will allow consulting experts from all around the world. Following this argument, Ondrus et al. [14] compared a management science approach (multi-criteria decision making) with an Internet based prediction market and concluded that none of the two approaches seems to be superior. However, the researchers also claimed that the output of the prediction market can be improved by restricting the market to the respective practice community with its experts.

The 1996 US presidential election is another good example of successful prediction markets in decision making. While the Democrats nominated Bill Clinton, who won the previous US presidential election, the Republicans had to select their candidate from a field of potential nominees. Among the nominees were Senator Bob Dole of Kansas, conservative columnist Pat Buchanan of Virginia, newspaper and magazine publisher Steve Forbes of New York, former Governor Lamar Alexander of Tennessee, Senator Richard Lugar of Indiana, and Senator Phil Gramm of Texas. During the fall of 1995, many speculated that former US Army General Collin Powell would also run for the presidential election. During the nominating contest, the Iowa Electronic Market (IEM) ran various prediction markets that the Republicans could have used to select their most promising candidate. Among others, the IEM offered markets on the nomination of Collin Powell, Bill Clinton receiving the most popular votes in the November election, as well as a conditional market to predict the percentage of votes that the Democratic nominee would receive if Robert Dole was the Republican nominee. The results of prediction markets suggested that Collin Powell would have been a strong candidate since on the day Collin Powell withdrew from the contest, the probabilities for Clinton winning the election increased significantly. On the other hand, the likelihood of Bob Dole being nominated and the success of Bill Clinton were positively correlated. As a consequence, one could infer that Bob Dole would have been a weak candidate. However, the Republicans did not follow the results of the prediction market to nominate Collin Powell and nominated Bob Dole, who at the end lost the November election [15].

Another example of how prediction markets can support decision making or FSS involves using macroeconomic prediction markets to effectively elicit and aggregate useful

information about future demand risk. Customer demand primarily depends on the current economic situation. Hence, the information contained in a macroeconomic prediction market helps to better estimate the future demand and allows a better coordination of the supply chain [16]. Following Guo et al. [16], macroeconomic prediction markets offer many advantages. First, previous prediction markets delivered remarkably good results in fields such as NFL or MLB games, U.S. presidential elections, or the box-office revenues of upcoming Hollywood movies [17–19]. Second, if the number of participants is sufficiently large [20], the predictions are not affected by nonparticipation or misrepresentation of the individual's information. Lastly, macroeconomic prediction markets are an open system that incorporates information from sources outside of the supply chain system.

Based on this idea, we decided to create our own FSS in the form of a unique macroeconomic prediction market that allows finance professionals and economists to share their opinion 24/7. The uniqueness of our prediction market is based on our belief that prediction markets can reveal much more valuable market information than most current prediction markets show. As a consequence, we designed our prediction market in such a way that not only the current market consensus will be disclosed but also the entire forecast distribution will be unveiled. We classify our online market as a prediction market since it is an electronic platform where participants can interact in accordance with their beliefs. After introducing the mechanics of our prediction market, we compare the results of our market with the Market News International (MNI) survey results.<sup>3</sup> In a subsequent step, we analyze the market error to highlight the essential effects of the wisdom-of-crowds phenomenon. Moreover, we comment on the role of updating with respect to the evolution of the consensus forecast and subsequently compare this effect with the wisdom-of-crowds effect.

## 2. Fundamentals of prediction markets

Throughout history, people have always aimed at predicting the future to improve their quality of living. Thales, a philosopher from Miletus had superior weather forecasting skills. One year, he predicted that the olive harvest would be exceptionally good. As a consequence, he entered agreements with local olive press owners that guaranteed him the exclusive rights to use their olive presses in that year. At harvesting time, Thales' predictions turned out to be true. Since the demand for olive presses exceeded the supply, he was able to sell his rights with a significant profit. If markets for information aggregation, such as prediction markets, had already been established at that time, Thales would have been unable to realize such a fortune since markets for information aggregation play a crucial role in the efficient allocation of resources [21]. Although people

<sup>3</sup> The MNI survey is a premier international economic survey, which polls leading economists each month to obtain their forecasts and views specifically for the Global Foreign Exchange and Fixed Income Markets. These surveys cover estimates for the principal macroeconomic indicators, including ISM Manufacturing Index, Producer Price Index, Consumer Price Index, International Trade Balance, Housing Starts, and Non-Farm Payrolls.

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