PolicyOracle: Nowcasting Expectations on Policy Indices

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1. INTRODUCTION

In our globally interconnected social and economic systems, policy decision processes could be greatly benefited by instruments able to aggregate and interpret heterogeneous and dispersed information among individuals and proactively sense possible problems concerning policy related matters. For instance, knowledge of the inflation expectations of the population may help the European Central Bank to devise a more effective monetary policy or access to expectations on CO_2 emissions may inform governments to adjust energy related policies. Several institutions collect expectations and periodically (monthly, quarterly etc.) release aggregated indices. The most widely used methods are typically based on surveys among experts (e.g. the ECB survey of professional forecasters (Garcia, 2003)), households or consumers and generally follow closely the economic situation and even anticipate turning points in the economic cycle (Manski, 2004). While the usefulness of monitoring expectations is not questionable, existing approaches commonly rely on survey-based methods and suffer from two major limitations. First they report indices with a lag: the survey data for a given period is generally released about halfway through the next period, while reported data are typically revised several months later. Second, they provide a rather partial view of a more complex dynamics. The reason is that such methodologies are not incentive-compatible (Hurwicz, 1972) and, therefore, might be of low precision in revealing the 'real' preferences and expectations of economic agents.

Pursuing the necessity of informing the policy decision process, we set out to use Information Markets (IMs) as an institution which efficiently aggregates diverse information using the price mechanism. IMs are considered an example of collective intelligence because of their capability to aggregate and nowcast information that arrives with a lag by making use of specifically designed contracts that yield payments based on the outcome of uncertain future events (Wolfers & Zitzewitz, 2004). Contract prices provide a reasonable estimate of what the traders in aggregate believe to be the probability of the aforementioned events. IMs are characterized by their accuracy, easy deployment, and ability to dynamically incorporate new information available to traders by continuously adjusting an event's price (Snowberg et al., 2012). However despite the expected benefits, the public sector seems rather reluctant to introduce IMs for improving public decision making. Hanson (2006) proposed information markets as a new tool that will revolutionize governance, while Ledyard (2006) and Hahn and Tetlock (2005) describe a framework and identify the main characteristics an information market should fulfill in order to perform well in situations relevant for policy decision making. Possibly one of the reasons for the public sector's reluctance to experiment with information markets (at least in the US) is related to the controversy and political debate raised around the Policy Analysis Market (Hanson 2007). Recently, however, the use of information markets has been suggested as a tool which can foster the participation of citizens in European public policy (Millard et al., 2009) or support macro-economic forecasts for governments (Teschner et al., 2011). In this paper, we describe our approach for an IM that supports aggregation of information from experts and interested stakeholders as well as citizens at large by considering their opinions and discussions as expressed in social media. Our approach is instantiated in a work-in-progress system called PolicyOracle.

2. OUR APPROACH

Our approach consists of three elements (Figure 1). The first element refers to identifying social media information sources which include opinions relevant to the public policy and extracting from them the

appropriate information (cf. A). As a second element (cf. B), a method for processing content is introduced (e.g. sentiment analysis for textual input). Third, the market is set-up and humans (cf. C) and/or computational agents (cf. D) participate in the trading process.
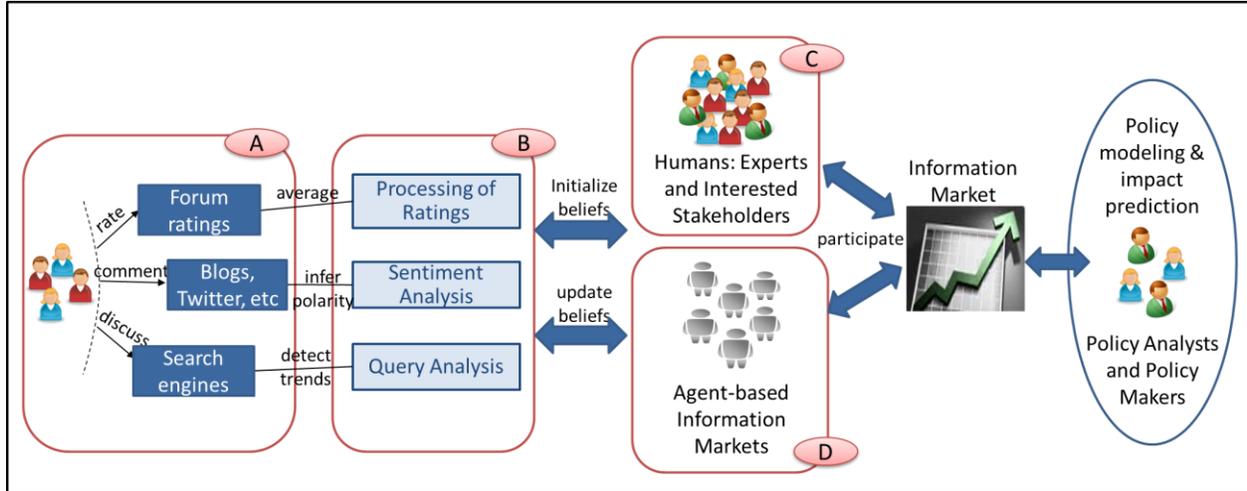

Fig. 1. The PolicyOracle approach: Experts and interested stakeholders participate in an Information Market together with computational agents that take as input user generated content from social media in order to provide forecasts of indices that support policy decision making.

2.1   Social Media for Public Policy Indices

Social media has recently exploded as a category of online discourse where people create content, share it, bookmark it and network at a prodigious rate (Asur and Huberman, 2010). Examples include Facebook, Twitter and a number of web forums. Because of their ease of use, speed and reach, social media are changing the public discourse and set trends and agendas in topics that range from the environment and politics to technology and the entertainment industry. Social media content contains an untapped collective wisdom that can be exploited, among other things, for aggregating opinions and preferences on various topics. The size and diversity of the information found in large user communities presents an interesting opportunity for harnessing that data into a form that may support decisions and choices among different outcomes. Our goal is to utilize web and social media content to predict public policy-related economic and social indices. The potential of search queries to predict macro-economic indices has been indicated by Askitas and Zimmermann (2009) who demonstrate strong correlations between keyword searches and unemployment rates using monthly German data. We aspire to leverage user expectations and opinions which concern policy options and are available on the web and social media. A critical task is to identify the appropriate information sources and develop information retrieval tools that are able to cope with various data sources, by exploiting the contextual information and domain knowledge attached to them as much as possible. Techniques such as opinion mining and sentiment analysis can be employed to generate quantitative information from qualitative user opinions expressed through, e.g., forum posts and comments. We aim to use extracted information in order to generate indexes that represent people's expectations on issues of interest for policy makers and policy analysts and use it as input for determining the beliefs of computational agents which will participate in information markets.

2.2   Information Markets for Policy Design

Whereas the forecasting performance of IMs has been proven when compared to other information aggregation mechanisms such as expert opinion, polls and surveys, the application of information markets for policy matters is associated to research challenges that concern the problem of liquidity,

the need for careful contract designs as well as the requirement of appropriate trading and incentive mechanisms. In the research effort we pursue here, we consider information markets designed to support decisions on policy matters where contracts yield payoffs contingent on the status of key policy variables. The relevant policy decisions could be private or public whereas markets will provide information related to a variety of public policy matters such as costs, benefits, net benefits of policy options or the likelihood of certain events depending on the choices of policy makers. We aim to design optimal market microstructures and securities to support human traders' and computational agents' participation in the markets increasing the capability to aggregate information. Of course, special consideration has to be given to the design of the securities which will be traded in order to avoid disclosure of sensitive information. Finally, appropriate mechanisms should be included to cope with any potential manipulative behavior of market participants.

3.   THE POLICYORACLE INFORMATION MARKET

The purpose of PolicyOracle is to allow policy makers to tap the collective opinions of the crowd and make better decisions about problems of global relevance spanning from economic, financial, to environmental and energy matters. The current version of the platform, among others, includes functionalities that allow trading of virtual contracts using an implementation of an automated market maker (Hanson, 2007) and discussions on the policy indices that are presented as contracts to participants (see Fig. 2).

Fig. 2. View of the PolicyOracle trading interface. Users can buy or sell shares of contracts that represent different answers to questions related to trends of policy indices. Moreover they can provide comments and opinions in a discussion forum.

In cooperation with policy makers and policy modelers from organizations such as the Global Climate Forum[1], Germanwatch[2] and the Bank of England we have already selected a number of key policy indices which are formulated as questions in PolicyOracle, and include trends on: Monthly Inflation Rates, Consumer Price Indexes, Unemployment Rates, Price of Carbon Emissions, Oil prices and Wholesale Energy Prices. Currently we are running our first experiments with a team of experts comprising of economists, policy modelers and stakeholders from the industry, coming from Germany, Italy, Spain and Greece. Our next steps include the design of contracts that, instead of trends, will measure expectations on ranges or exact values of the selected policy indices as well as the integration of the computational agents that will leverage social media information and participate in PolicyOracle together with humans. PolicyOracle is available online at: http://www.policyoracle.org.

[1] http://www.globalclimateforum.org/
[2] http://germanwatch.org/en

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