Information Markets for Social Participation in Public Policy Design and Implementation

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Abstract

In this paper we propose a research agenda on the use of information markets as tools to collect, aggregate and analyze citizens' opinions, expectations and preferences from social media in order to support public policy design and implementation. We argue that markets are institutional settings able to efficiently allocate scarce resources, aggregate and disseminate information into prices and accommodate hedging against various types of risks. We discuss various types of information markets, as well as address the participation of both human and computational agents in such markets.

Introduction

In social and economic systems, sentiments, beliefs and opinions are heterogeneous and dispersed among individuals. Proper instruments able to aggregate and interpret this dispersed information could be instrumental in deriving more efficacious policy design and governance processes. For instance, knowledge of the inflation expectations of the population may help the European Central Bank to devise a more effective monetary policy. Or, on a local level, the selective and targeted monitoring of citizens' opinions can support policy makers in effective city administration, while at the same time creating an enduring bond between citizens and administrators, based on active participation, trust and transparency.

Nowadays several institutions collect data on sentiments of investors and consumers and periodically (monthly, quarterly etc.) release aggregated indices. These indices are typically based on surveys among financial experts, 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, opinions and sentiments of economic agents is undoubted, these indices have two severe limitations. First they are only available with a lag: the survey data for a given period is generally released about halfway through the next period, and are typically revised several months later. Second, they give 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.

In this paper we argue for a research agenda that could exploit the wealth of information within social media with the following aims: (i) to allow cost-effective and almost real-time opinion and sentiment monitoring and aggregation; (ii) to create incentive compatible mechanisms for information aggregation and thereby improve their overall precision and effectiveness; and (iii) to convert the citizens from passive users of policy design results into active participants of public policy modeling.

The research question is how to combine the advantages of emerging social media in connecting large numbers of active users with incentive compatible mechanisms of preferences and/or expectations revelation and aggregation.

We propose the `market´ as an institution which efficiently aggregates diverse information using the price mechanism and the Web as the medium where 'information markets' can be created and run.

In the following we discuss our research efforts towards exploiting the synergies between information markets, as institutions able to efficiently aggregate disperse information among participants, and the possibilities for the discovery and aggregation of opinions, mood and sentiments of web citizens from social media, with the overall aim to support policy makers in effective and socially-inclusive governance of their institutions.

A Market-based Approach for Public Policy

Our information market approach to participatory public policy design and implementation 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. In the following subsections we discuss the research issues and challenges in each of these elements.

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.

Prior research provides evidence of the predictive capabilities of social media and identifies correlations between user generated content and the occurrence of future events. Gruhl et al. (2005) have shown how to generate automated queries for mining blogs in order to generate indices to forecast spikes in book sales. Predicting movie sales has received significant interest as well. Researchers typically use meta-data information on the movies themselves to perform the forecasting, see e.g. (Joshi et al. 2010) and (Krauss et al. 2008); or forecast box-office revenues by building regression models (Asur and Huberman 2010).

Our research goal is to utilize web and social media content to predict public policy-related economic and social indices. The recent work of Choi and Varian (2009) shows that trends in user queries can provide forecasts on various business metrics. The potential of search queries to predict macro-economic indices has also 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. Moreover, extracted information can also be used as input for determining the beliefs of computational agents which will participate in information markets.

Information Markets for Policy Design

We are interested in markets, not as resource allocation mechanisms but as an incentive compatible information revelation and aggregation mechanism. A well-known intuition, which dates back at least to (Hayek 1945) is that in a competitive market the equilibrium price should be able

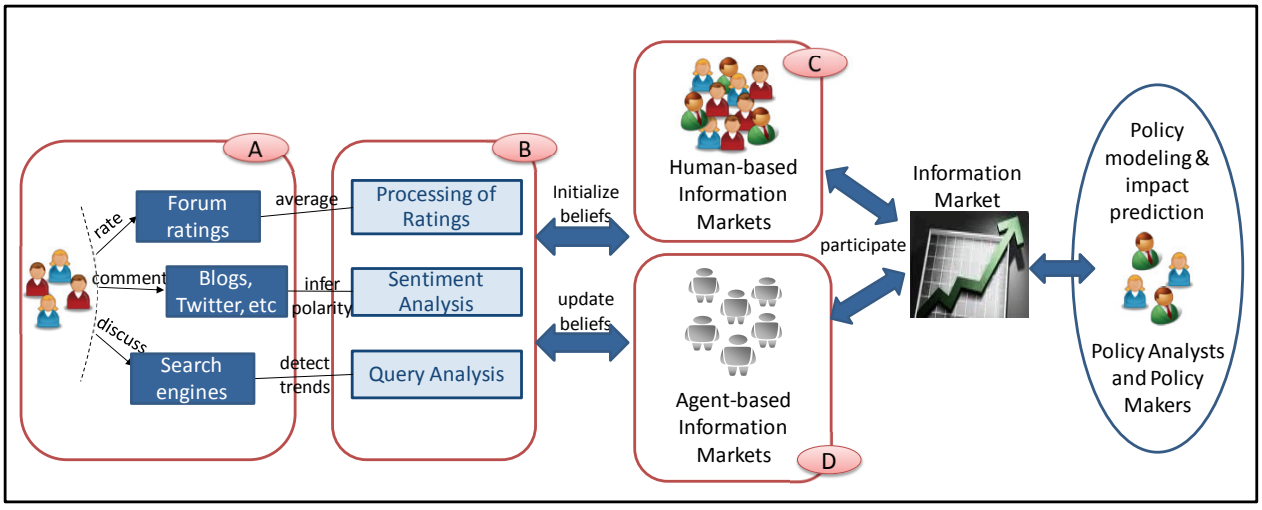

Figure 1. User generated content from social media as input in information markets for public policy

to transmit, aggregate and publicize all the private information distributed across a system of dispersed individuals. Information markets have been developed as tools to elicit from economics agents the most truthful revelation of their expectations and knowledge about future events (Wolfers and Zitzewitz 2004) and represent the 'wisdom of crowds' (Surowiecki 2004).

Information Markets are markets designed and run for the primary purpose of mining and aggregating information scattered among participants and subsequently using this information in the form of market values in order to make interpretable predictions about specific future events. Information markets make use of specifically designed contracts that yield payments based on the outcome of uncertain future events and differ from traditional equity markets in that they are not typically tied to a claim of corporate ownership. Instead, the assets are claims whose payoff is tied to some future specified contingency (Abramowicz 2004).

In recent years, a significant increase has been documented both in the academic literature (Tziralis and Tatsiopoulos 2007), as well as on practical corporate applications in companies like HP, Microsoft, Google, Siemens and Eli Lilly which have experimented with information markets to forecast sales, the success of new products or even estimate completion time of projects (Tziralis et al. 2008).

The public sector on the other hand seems rather reluctant to introduce information markets in order to improve public decision making, despite the benefits expected. In particular, Hanson (2006) proposed information markets as a new tool that will revolutionize governance, and 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).

Whereas the forecasting performance of information markets has been proven when compared to other information 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 advocate 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 ensure the citizens' participation in the markets increasing the capability to aggregate information. Regarding citizens' preferences, these will be measured by trading securities whose prices shall be based upon shares of choice of policy options. In this setting participants invest on the policy options they prefer rather than expressing their expectations on policy variables. 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.

Preliminary Research Results

We have piloted the use of information markets for public policy in two occasions. First, we designed and run an information market for public consultation on the use of Information and Communication Technologies (ICT) for energy efficiency, as part of a participatory policy making initiative of the European Commission. The purpose was to allow people to submit and evaluate future research directions relevant to the use of ICT for enabling energy efficiency. Ideas placed in the market had the benefit of being scrutinized by a wide range of peers. An initial number of three ideas were used as a seed. Traders were able to enter new ideas in the first of the three weeks of market operation. Non-monetary and monetary incentives were provided to the idea creators and the market winner. During the trading period 561 transactions occurred by 63 participants, a fairly diverse group from 10 European countries, with wide age span, experience and professional background. Pilot evaluation through questionnaires and interviews revealed both a positive feedback from market participants and EC officers, as well as suggestions for improvement, such as the possibility to synergistically formulate ideas.

A second pilot focused on re-designing educational policy on religion. The pilot was initiated by a German local government with the goal to evaluate ideas for re-factoring the 'Bible history' course in high schools. The state officials wanted to modernize the course in order to address the needs of a multi-religion society. The project was carried out in two phases. Initially a web-based forum was setup where the citizens could submit ideas and views on the issue while engaging in an online discussion. The purpose of the forum was to gather citizens' views and re-

mained open for two weeks. Next, contributions were processed by the officials and a set of seven ideas were derived. These seven ideas were represented as contracts in the market. During two subsequent weeks, participants expressed their opinion by investing on their preferred ideas but could not propose new ideas. During this period, 43 participants engaged in 302 transactions. Evaluation was conducted using two different questionnaires, one for citizens and one for state officials. Besides the overall positive feedback from both citizens and state officials, some concerns that need further examination were raised regarding possible manipulation effects and speculative bubbles in the market as well as the fuzzy link between the market outcome and the actual decision making.

Future Research Directions

In this paper we have sketched an information market-based approach for social participation in public policy matters and outlined a number of related research issues. We believe that human-based information markets are quite promising as tools for public policy design and impact prediction. Nevertheless, there is still a need for lowering several legal and regulatory barriers to allow their full use (Arrow et al. 2008).

As discussed above, the application of information markets in policy design can be restrained if participation is limited and hence liquidity is inadequate, and if no participation incentives are provided. Moreover, information markets can only aggregate information available to participants and not the wealth of information available on-line.

We believe that a promising research dimension is to investigate at which extent the use of computational agents, whose trading behavior is driven by opinions and sentiments from the Web in general and social media in particular, can solve such problems. Our early research results in this direction are quite positive (Bothos, Apostolou, and Mentzas 2010) and point the way towards the use of artificial markets for aggregating information at a large scale and enabling socially productive innovation.

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