

**Leaping into the unknown: Comparing, testing, and
applying methods of predicting elections**

Sveinung Arnesen



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Department of Comparative Politics

University of Bergen

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Abstract

The purpose of this dissertation is to compare, test, and apply methods of predicting election outcomes. It discusses the premises of the predictions and what kind of information is gathered and processed to form expectations about election results. It also elaborates on how making predictions can help us gain insights into voter trends and the causes of electoral outcomes.

The first article, entitled *Out of work and out of office: The golden mix for left bloc support*, applies *ex post* predictions from an economic vote model in an effort to test the prevalence of economic voting in Norway. Across established democracies, the relationship between the economy and party choice is robust. In efforts to test the relationship further, forecasting models based on economic and political variables have been constructed for many democracies, most notably in France, the United Kingdom, and the United States. This work has produced an effective body of theory and empirical research on predicting election outcomes before they happen. However, for certain other democracies, such as Norway, little or no election forecasting has been carried out. The first dissertation article draws on established relationships from the economic voting literature and tests for their presence in Norwegian politics. I find that the left bloc's vote share is sensitive to unemployment and whether or not they are in government. In line with the clientele hypothesis, the vote for the left has a positive relationship with unemployment figures. In addition, I find that being in office leads to a general depreciation of their vote share over time. The vote forecasting model constructed with these predictors is tested against and outperforms an AR(1) benchmark model for sequentially updated *ex post* predictions of the last ten Norwegian elections.

The second article, entitled *Information, motivation, prediction: An experiment with prediction markets during the 2009 Norwegian national election campaign*,

discusses the premises behind the formation of expectations about future election results, and what kind of information these expectations are based on. Most notably, this article presents the very first experiments conducted with prediction markets in a Norwegian electoral context. The aims of the trials were to measure the accuracy of this prediction method in a multiparty context such as the one in Norway, to test the effect that monetary incentives have on the traders' activities in a prediction market, and finally to compare how accurate prediction markets that consisted solely of active party members as traders were relative to the predictions made by "regular" prediction markets. Our results reveal that multiparty elections like the ones held in Norway are not an impediment to accurate predictions, that monetary incentives seem to bolster trading activity, and that active party members show signs of optimism bias when compared to markets with participants that were not active party members.

The third and final article, entitled *How prediction markets help us understand events' impact on the vote in US presidential elections*, argues that pre-election polls and prediction markets reflect two different processes that, when analyzed together, can help us understand if and how key events that occur during an election campaign influence the final outcome of the election. While polls can be seen as reflecting an enlightening process where voters come to realize their vote preferences, prediction markets naturally incorporate this process into their predictions. In the research behind this article, I study the movements of weekly poll ratings and IEM market predictions and measure the impact that selected events have on polls and predictions in the run-up to the US 2004 and 2008 presidential elections. I conclude that the Swift Boat Veterans for Truth ad campaign in 2004 was an enlightening event that moved poll ratings in favour of President Bush – towards the level already predicted by the IEM market even before the Swift Boat event. The financial crisis in 2008, on the other hand, was an enlightening event. It came as news to both market traders and poll respondents, and effectively sealed the victory for Obama.

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3:

Arnesen, Sveinung. 2011. "How prediction markets help us understand events' impact on the vote in US Presidential Elections". *The Journal of Prediction Markets*. 5 (3):42-63.

To facilitate the read of the text, the three articles are nicknamed respectively 1) *the economic voting article*, 2) *the Norwegian prediction market article*, and 3) *the US prediction market article*.

PART I

Introduction

This dissertation is about predicting the outcome of political elections. It debates a number of questions revolving around this topic: Which method yields the most accurate predictions? What premises are the predictions founded on, and what kind of information are the predictions based on? What can we learn about voter trends by predicting elections? And in what ways, if any, do political preferences affect expectations about the election outcome, and vice versa?

The dissertation focuses on two approaches of relevance to political science, namely those based on economic vote forecasting models and those based on prediction markets. As the baseline method, polling of representative samples of voters will also be considered. One of the dissertation articles is about the very first experiment that used prediction markets within the Norwegian context. It addresses the obvious question of how well prediction markets perform in the context of Norway's multiparty elections, but it also considers two other relevant questions about prediction markets: Are monetary incentives a better motivator than non-monetary incentives for traders in prediction markets? Does the composition of traders matter for the accuracy of prediction markets?

Pure interest in the outcome is in itself a motivation for analyzing election predictions, but to predict the unknown result of a future event is also part of a learning process about the causes of the election result. Scholars in the field of economic voting have long used out-of-sample predictions to test the robustness of their models. Such predictions have not been applied to the Norwegian polity, and the motivation for one of the dissertation articles is to use out-of-sample predictions to test the presence of economic voting in Norway.

Another dissertation article analyzes time series data of both prediction markets and opinion polls in the 2004 and 2008 US presidential elections in an effort to distinguish if and how these two mechanisms react to a selection of events that occur during the campaign periods. Do the poll respondents and the market traders react similarly to those events? Previous literature suggests that they do not, and this is also what I find in my analysis. Hence, the prediction markets represent new and appealing sources of data that can be used to supplement polling data when studying voter trends during election campaigns.

Part I of this dissertation puts the subsequent journal articles in their theoretical context, and thereby shows how they are tied together. The first chapter elaborates on economic vote forecasting models, while the second chapter focuses on prediction markets. Part I ends with a discussion about the data and methods applied in the articles, and a short conclusion about the findings.

Economic vote forecasts

Economic voting is a field of study that mixes politics and economics by means of econometrics (Lewis-Beck and Paldam 2000). The theory originates with the *responsibility hypothesis* inspired by Downs (1957), and states that “voters hold the government responsible for economic conditions” (Nannestad and Paldam 1994:215).¹ ² Starting with the pioneering works of the early 1970s (Goodhart and Bhansali 1970; Kramer 1971; Mueller 1970), the field of economic voting has explored empirical relationships between economic/political variables and political preferences as measured by surveys conducted at the aggregate level (Mueller 1970; Beck 1991b; Norpoth 1984), at the individual level (Fiorina 1981; Kiewiet 1983; Miller and Listhaug 1984), or as aggregate vote outcomes (Tufte 1978; Fair 1978; Madsen 1980). The majority of economic voting models build on traditional theories of voting behaviour, incorporating concepts from socio-psychological and rational choice approaches such as party identification (Campbell et al. 1960, 1966), retrospective evaluations (Key 1966; Downs 1957), and prospective evaluations (Fiorina 1981) in one form or the other as independent variables. However, these models have also made contributions of their own to electoral research. Most notable, perhaps, is their emphasis on the link between the economy and vote choice. Certainly, the economic interests of the voters had always been a central factor, especially in the rational choice approach, but economic voting models place economic indicators at the core of their empirical approach.

¹ It is also known in the literature as the *referendum hypothesis*. (Tufte 1978)

² Another definition of economic voting is “any change in a voter’s support for parties that is caused by a change in economic perceptions”. (Duch and Stevenson 2008:41) This is more general, as it does not assume that voters only react towards the incumbent parties, but react to economic situations in ways that send signals to all politicians.

Another characteristic of economic voting is the use of predictions to test the reliability and validity of their econometric models. In this section I will elaborate on this point, and display how I have used predictions in my economic voting article on Norway to test the robustness of my model. The findings of the article are discussed in light of previous research on economic voting, both internationally and domestically.

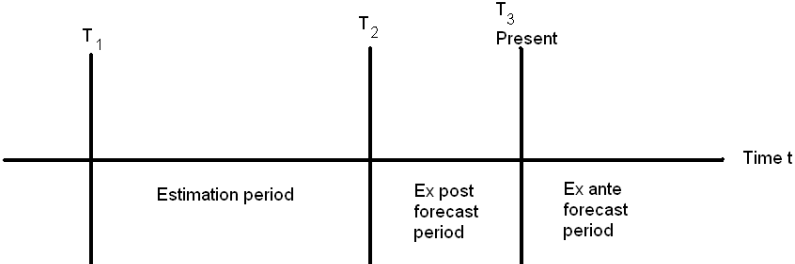
Using predictions to test models

Testing the relationships between variables by means of prediction is a natural component of robust econometric models (Armstrong 2001), and is a good way of guarding against the over-fitting of historical observations (Beck 2000). Even when a model has a good in-sample fit for historical observations, it may not be as adept at predicting future events. This could be a sign that the explanations are idiosyncratic for the specific estimation period, and are not generalizable for a longer time span. If the model does accurately predict observations outside the estimation period, then one may claim with greater confidence that the mechanisms of the model are valid independent of the time period covered by the sample. Tufte (1978) was the first to predict elections in the field of economic voting when he found that GDP per capita and individuals' perceived change of the economic situation were good *ex post* predictors of US presidential election outcomes in the post-Second-World-War period. Fair (1978) also produced forecasts for those elections, while Frey and Schneider (1979) used *ex post* forecasts of German popularity polls to see how well their *politometrics* model predicted party support in opinion polls. Soon after, such models would proliferate, and with Lewis-Beck and Rice (1984), the first *ex ante* forecast of an election result was published.

The difference between an *ex post* forecast and an *ex ante* forecast is that the former is made when the result is already known, while the latter is a pure forecast of an election which has not yet taken place. *Ex ante* predictions are

useful because the results are honest: One cannot bend the data to an outcome that one does not know. They also appeal to the general audience, since they make projections about an event which many people take an interest in. As depicted in figure 1, Pindyck and Rubinfeld (1998) have illustrated how the two types of prediction relate to time and to the estimation period used to construct the model.

Figure 1: Ex post and ex ante predictions.



Source: Pindyck and Rubinfeld (1998:Figure 8.1)

Especially in the US, election forecasting models have gained ground (Campbell 2000), but they are also prevalent in Europe, most notably in the UK and France (Lewis-Beck 2005; Bélanger, Fauvelle-Aymar, and Lewis-Beck 2007). When forecasting the vote, the models typically include between two and five theory-based variables, representing measures of the state of the national economy, party identification, incumbency, cost of ruling, and other political variables. Jones (2008) presents an overview of the various forecasts made for the 2004 US presidential election. Some of the variables used within the models are:

- Past or anticipated economic conditions
- Duration/alternation of parties in White House
- Public’s approval of presidential performance
- Incumbency of the candidate (during re-election campaigns)

- Candidate's success in primaries
- Candidate's strength in polling
- Party of the incumbent president
- Government fiscal policy
- Voter support of a party in Congress
- Whether or not the nation is at war

Those forecasts are representative of earlier models as well, since the forecasters aim to maintain similar or identical models over a long time span in order to gather a growing number of *ex ante* prediction observations for the same models.

Even though vote model forecasts are common, some democracies still lack such models. Most of these countries are newly democratized countries, but Norway stands out as one of the few “neglected” established democracies. Hence, one of the objectives of my economic voting article was to fill this gap. The main goal of the article has been to use prediction as a tool to test the assumptions that the model makes about economic voting in Norway. As the article stands today, only *ex post* predictions are available, but the model can also produce *ex ante* forecasts. Since it is conditional on unemployment figures from the election year and information about who is in office in the election year, however, such a forecast will not be ready before the 2013 election year.

In the discussion that follows, I give a brief review of the existing literature on economic voting in Norway. Afterwards, demonstrate how my article relates to economic voting in Norway.

Economic voting in Norway

Previous studies on whether Norwegians are economic voters have been inconclusive.³ As a consolidated democracy with vast revenues from oil, Norway has some peculiarities that it does not share with comparable countries. Aardal and Listhaug (1986) note that Norway, due to active counter-cyclical policies from the government and the growth impulse from the oil sector of a lesser degree than in other industrialized countries, suffered from an economic downturn in the mid-1970s. National revenues are positive, and the last time the country experienced economic contraction was in the early 1990s. Nevertheless, few incumbent governments survive an election in Norway. Until it happened in 2009, no government had been reelected since 1993, in spite of the great economic prosperity witnessed in this period. Paradoxically, after the financial crisis struck in 2009, the government held on to power. Jenssen and Kalstø (2011) hypothesize that the two former incumbent governments in 2001 and 2005 suffered from rising economic expectations which they were unable to satisfy, while in 2009 the citizens had witnessed through the media a global financial meltdown which they believed would strike Norway as well. In some economic sectors it did, but an overall downturn failed to materialize, and citizens approved of the government's efforts to mitigate the impact of the global crisis on the national economy (Narud 2011). The *lowered expectations* explanation does not discard the link between the economy and the vote, but instead suggests that the objective economic numbers may be perceived differently depending on the context. Economic growth may be lower than for previous periods, but if the voters' expectations have also been lowered, the party or parties in government will not necessarily be punished for slower growth.

Over time, however, if there is a connection between the economy and the vote, it should appear as an empirical relationship between objective assessments of the state of the economy such as unemployment, GDP growth, inflation, or other

³ Elements of this text are drawn from my economic voting article on Norway (Arnesen 2011b).

measurable barometers of economic development (Duch and Stevenson 2008; Clarke et al. 2009).

For my analysis of the left bloc's aggregate vote share, I included both local and national election outcomes, beginning in the post-Second-World-War period and ending with the 2009 election, which resulted in 33 time series observations in total. The independent variables in the full model included a dummy variable for elections in which the left bloc is the incumbent bloc, annual unemployment figures measured in percentage of work-eligible population in the election year,, GDP growth in per cent per year as well as annual inflation rates in the election year, and an autoregressive component of the dependent variable to account for omitted variables such as party identification. Interaction effects of incumbency on the mentioned variables were also included, as well as a local elections dummy variable to account for differing outcomes between national and local elections.

The model which had the best in-sample fit was chosen as the final model. In addition to the local election dummy and the autoregressive component, the model contained an incumbency variable as well as an unemployment variable, with negative and positive effects, respectively, on the left bloc's electoral support. This final model was tested against an atheoretical benchmark model by producing *ex post* forecasts for the last ten Norwegian elections. The atheoretical model contains two of the components from the economic model: one dummy variable which accounts for differences in left bloc support between local elections and national elections, and the AR(1) component which accounts for any omitted variables. The difference that remains between the two models, then, is the two theoretical variables *incumbency* and *unemployment*, thus making the *ex post* predictions a test of the usefulness of keeping these two variables as predictors of election outcomes for the left bloc.

Using AR components in a benchmark model is not customary in political forecasts, but Brandt, Freeman, and Schrodtt (2011) note that this is a regular

practice in meteorology, and they suggest that political scientists can learn something from that field. An AR benchmark model is a tougher hurdle to overcome than alternative benchmarks such as a “no-change” forecast. As the paper reveals, the *ex post* forecasts of the economic model outperforms the benchmark model, and we can conclude with greater confidence that there is evidence of economic voting in Norway.

The results in my economic voting article on Norway are consistent with those studies that point to the existence of economic voting in Norway, as the aggregate election outcomes for the left bloc show significant changes depending on the level of unemployment and incumbency (i.e. the cost of rule). The relationship is positive: When unemployment goes up (or down) support at the polls for the left bloc goes up (or down). This tells us that the voters do not necessarily blame the government for the unemployment rate, but rather vote for those parties which they believe have the best ability to do something about it. Whenever the unemployment rate decreases, the left bloc loses electoral support. The fact that national unemployment stands out as perhaps the most fundamental economic variable concurs with international literature (Gelman and King 1993; Wlezien and Erikson 2004; Kinder and Kiewiet 1979; Lewis-Beck and Paldam 2000; Frey 1979), and is in agreement with the *clientele hypothesis*. The clientele hypothesis states that in times of economic prosperity voters will flock towards the right, and when the economy is faltering and the citizens fear for their jobs they flock towards the left (Carlsen 2000; Rattinger 1991; Swank 1993). They do so for a good reason, as parties on the left side of the ideological scale historically have had a stronger focus on employment than those on the right (Hibbs 1977). Conversely, the non-socialist parties maintain issue ownership on controlling inflation and fostering economic growth.

It has been said that the main problem in the economic voting literature is that the vote/popularity functions lack stability (Lewis-Beck and Paldam 2000;

Nannestad and Paldam 1994). This could be the reason we see a variety of different findings in the literature regarding economic voting in Norway. Duch and Stevenson (2008) take on this issue in depth, covering 163 different election surveys from eighteen countries between 1979 and 2001. Their main conclusion from their vast data set is that levels of economic voting vary across time and space. The reasons for the variation are institutional differences among the polities, as well as contextual circumstances for a particular election. The effect of economic issues may also be suppressed in certain elections if other issues are more salient at the time. Add to this that economic voting in Norway has become increasingly important over time, as Miller and Listhaug (1984) pointed out almost three decades ago, and we realize that model specifications (for example choice of estimation period) may significantly influence our results. However, making sequentially updated *ex post* forecasts like I did in the analysis will mend this problem, as the predictions are made by re-estimating the model from a sample which includes all observations up until the predicted election (Brandt et al. 2011).

That said, the finding that the left bloc faces incumbency costs whenever they are in government is in line with the most robust finding in economic voting, namely that incumbency *as such* puts the government out of favour with the electorate. As Norpoth (1991:143) writes, "... as long as people have chosen political leaders through some form of election, it has been noted, almost like a law of politics, that popularity diminishes with time in office." In Norway there is also empirical evidence of a general depreciation of the incumbents (Nannestad and Paldam 2002; Midtbø 1999). More specifically, decreasing support comes as high expectations of the newly elected leaders turn into citizen disillusion as political decisions antagonize parts of the electorate (Mueller 1970), or the voters simply have expectations that the new government cannot fulfill (Stimson 1976). An alternate explanation of the citizens' apparent need for government change is that the electorate displays variable political preferences for keeping the policy

outcomes stable at the centre of the ideological spectrum (Paldam and Skott 1995).

In summary, *ex post* and *ex ante* predictions of election outcomes have long been used in economic voting studies to test the robustness of the econometric models. I apply that method to Norwegian politics, and by doing so I find that my in-sample model that includes national unemployment and incumbency is also valid for observations out-of-sample. At this point in time the predictions have only been made *ex post*, but when election year 2013 comes about it can be used for *ex ante* predictions as well.

In the next part, I discuss the theoretical context of my two articles on prediction markets. These markets take a totally different approach to forecasting election outcomes than vote models do, which I will elaborate on at the outset. Information is key when forming expectations, and I compare the characteristics of vote model forecasts and prediction markets.

The accuracy of the market predictions are normally compared with opinion polls, and so far they have had an edge over the polls (Berg et al. 2008a; Berg et al. 2008b). I discuss why this might be the case, but also point to competing views and to potential pitfalls of aggregating predictions through a market design. Prediction markets are still fairly fresh in political science, and there are many unanswered questions, which my article on prediction markets attempts to address. In my article on US prediction markets I utilize time series data from prediction markets to gain insight into what kind of election campaign events influence party preferences and the expected election outcome.

Prediction markets

While vote forecasting models have developed naturally from economic voting research, the study of prediction markets does not originally stem from political science. Instead, the study of prediction markets has been dominated by economists and psychologists who take an interest in the market dynamics and in the behaviour of the traders in the markets. However, prediction markets are also of great interest to political scientists. First, they were invented with the goal of predicting political elections. Second, the data which these markets produce are a pool of resources which allow one to study movements in and levels of party or candidate popularity in the run-up to political elections.

Prediction markets as defined by Berg, Nelson, and Rietz (2003) are markets run with the purpose of using the information content in market values to make predictions about specific future events. They are also known as information or decision markets. The intention of these markets is to show the traders' best collective guess about future events such as election results, stock prices, and movie revenues. In these markets, values of traded contracts depend directly on future outcomes and, hence, prices give information about what traders believe will be the most probable outcomes (Berg et al. 2003:79). Today there are a number of prediction markets, but perhaps the best known prediction market is the Iowa Electronic Markets (IEM), which was first established at Iowa University for experimental purposes in connection with the 1988 US presidential election. The IEM political markets are electronic real-time exchanges where traders buy and sell futures contracts, with payoffs based on the ultimate election outcomes. Because real money is used, traders are subject to the monetary risks and returns that result from their trading behaviour. In the market, traders "discuss" probabilities of an outcome through the offering and accepting of prices. If structured correctly, the prices should reflect the expected future outcome, given the information available at the time:

Though simple in concept, such markets act as complex, dynamic, interactive systems that incorporate information in new ways. Through the action of traders, prediction markets aggregate information from individuals, incorporate polls and other sources of information and weight all of this information through the price formation process. Berg, Nelson, and Rietz (2003:3)

The IEM consists of two types of markets: winner-takes-all markets and vote-share markets. In a vote-share market, traders buy and sell contracts with payoffs of \$1 multiplied by the relative vote share taken by the candidate or party in the forthcoming election. The contracts thus represent the traders' consensus on the most likely vote share for the political candidate connected to each contract. For example, if a vote-share contract on party A was traded at a price of \$0.51, this means that the vote share prediction for that party was 51 per cent. Vote share markets are most easily comparable to polls, and are therefore the kind of markets being analyzed in my two prediction market dissertation articles. The winner-takes-all market (WTA) is a binary market where the traders invest in the probability that one of the candidates will win the presidency. The contracts are liquidated at \$1 if the candidate wins the election and \$0 if another candidate wins.

Information and expectations

In comparison to economic vote models, prediction markets utilize a very different kind of information in forming expectations about the upcoming election outcome. Vote model forecasts are made by a scholar who seeks stable relationships between variables in formal expressions. The predictions in a prediction market, on the other hand, are the product of supply and demand for the contracts in the market. The interaction between traders decides the prediction, and their evaluations and justifications for the predictions are

concealed to us. Hence, while vote models rely on general relationships between the vote and economic/political variables, the prediction markets rely on the traders' knowledge of the particular circumstances of time and place.

Table 1: Contradictive characteristics between the design of structural vote models and prediction markets

Vote models	Prediction markets
<i>Centralized:</i> One expert	<i>Decentralized:</i> Many experts
<i>Formal:</i> The vote is predicted by a few, explicit variables influence the aggregate vote	<i>Informal:</i> The vote is predicted through the traders' knowledge of the particular circumstances of time and place.
<i>Rigid:</i> Not adjustable to context	<i>Flexible:</i> Adjusts to context
Interaction between <i>variables</i>	Interaction between <i>traders</i>

Source: Arnesen (2005)

To shed light on the differences between these two methods of election prediction, we shall consider the debate between John Maynard Keynes and Friedrich von Hayek on the formation of economic expectations. Their positions in economics resemble the differences between the information that material vote models and prediction markets use to form expectations about election outcomes.

Keynes had his name attached to the tradition that the economy could be adequately supervised, forecasted, and controlled by a few experts through the development of macroeconomic models explaining the relationship between aggregated indicators such as GDP, inflation, and unemployment. His concern was how to "tame" the real world, with all of its unpredictable shifting functions and unforeseen changes (Kregel 1976:211). This was best done by developing macroeconomic models that study the relationship between aggregated indicators of the whole economy. He ignited the belief that simple, stable, and

predictable relationships between macroeconomic variables could be identified, and that the economy could be controlled and manipulated with a relatively high degree of certainty. Hence, a planned economy in which the government controls and regulates production, distribution, and prices would be both plausible and desirable.

An opponent of Keynesian economic thinking was Friedrich von Hayek. In his article entitled "The Use of Knowledge in Society", Hayek (Hayek 1945) attacks the proponents of central economic planning. He argues that it is impossible for one or a few experts to gather all relevant knowledge of the various factors which could potentially influence the development of the economy. To Hayek, the use of statistical aggregates was an oversimplification of the real world which, although useful for theoretical purposes and for preliminary studies, had no direct relevance to the solution of practical economic problems (Hayek 1945:530). In a later essay, he elaborates his criticism of Keynes:

Keynes' theories will appear merely as the most prominent and influential instance of a general approach whose philosophical justification seems to be highly questionable. Though with its reliance on apparently measurable magnitudes it appears at first more scientific than the older micro-theory, it seems to me that it has achieved this pseudo-exactness at the price of disregarding the relationships which really govern the economic system. Even though the schemata of micro-economics do not claim to achieve those quantitative predictions at which the ambitions of macro-economics aim, I believe by learning to content ourselves with the more modest aims of the former, we shall gain more insight into at least the principle on which the complex order of economic life operates, than by the artificial simplification necessary for macro-theory which tends to conceal all that really matters. (Hayek 1978:105-106)

Hayek's main point of contention with Keynes is the belief that all relevant knowledge needed for correct foresight of the economy can somehow be given to one single mind. Economists, says Hayek, forget about the constant small changes which make up the whole economic picture. The continuous flow of goods and services is maintained because individuals constantly adjust to new circumstances. By nature, statistical aggregates cannot account for all these small changes, which are adaptations to the particular circumstances of time and place. They are generalizations of the real world that are so imperfect that they cannot be used for practical purposes such as forecasting and planning the economy. In other words, Keynes' theories "tame" the economy so much that it is not recognizable in the real world. Rather than centralizing economic planning, planning should be left to those who are familiar with the particular circumstances. Hayek reasons that the best mechanism for this is a price system. Divided planning among many individuals is more efficient than central planning by one authority because every individual will bring his/her unique information to bear and affect the aggregate price in the market (Hayek 1945).

As a consequence of their differing methodological approaches to economic theory, their opinions differed about how much formal understanding one could have about the economy. While Keynes was concerned with exploring how the economy worked, Hayek was more sceptical with regards to how much we actually could learn about this. The scientific approach of searching for general rules could, by its nature, not absorb all relevant knowledge about the real-world economy. This was, in his mind, a habit of thought which mistakenly had been transferred from the natural sciences. He argued that when dealing with social processes such as economics, mathematical equations systematically left out important aspects of the economic realities:

Today it is almost heresy to suggest that scientific knowledge is not the sum of all knowledge. But a little reflection will show that there

is beyond question a body of very important but unorganized knowledge which cannot possibly be called scientific in the sense of knowledge of general rules: the knowledge of the particular circumstances of time and place. (Hayek 1945:521)

It should be noted that none of them personally believed in perfect foresight. In order to be able to make general models, Keynes nonetheless had to disregard this realization. He differentiated between short-term expectations which could be disappointed by actual developments, and long-term expectations which were not influenced by short-term fluctuations. Hayek, for his part, realized that the market could only reach perfect equilibrium under static circumstances. The actual economy is continuously changing, and the market will adapt to these changes, but never fully catch up with the real world.

One might here add another challenge to perfect economic foresight, and that is the effect that the predictions themselves have on the economic outlook. Actors want to profit from an anticipated upturn, and alternatively secure their savings when bad economic times lie ahead. In light of this, an incorrect forecast may become true because of people's reactions to it. Robert Merton was the first to coin the term *self-fulfilling prophecy*, and defined it as "a false definition of the situation evoking a new behaviour which makes the original false conception come 'true'" (Merton 1968:477).⁴ One example of a self-fulfilling prophecy is Moore's law. Moore (1965) observed a pattern where computer hardware capabilities would double approximately every two years. He predicts that this

⁴ The phenomenon has, however, been pondered since ancient times. Popper (1976) called it the *Oedipus effect*, after the story about the Greek king who had been told by the oracle that he was going to kill his father and marry his mother. In order to avoid this fate, he moved away from his parents. On his journey he ended up in a fight with a stranger. He killed him in the fight, and later married the stranger's wife. It turned out that the stranger was his biological father, and his new wife was his biological mother. Because it played a most important role in the sequence of events which led to the fulfilment of its prophecy, the effect was named after the oracle.

trend would also continue in the future. As this “law” became accepted within the computer industry, it started to serve as a goal the industry needed to meet when manufacturers developed new products. Hence, what initially was an observation of past trends turned into an expectation of future developments, which in turn materialized at least partly because people believed it was going to happen.

Shifting back to electoral studies, self-fulfilling prophecies may take the form of a *bandwagon effect*.⁵ Lazarsfeld (1944) discovered that many respondents who were undecided half a year before the election but had anticipations about the winner, later would decide to vote for the candidate they expected to win. Several scholars since Lazarsfeld have picked up on this phenomenon, exploring the existence of what has become known as the *bandwagon* and *underdog effects*. The former occurs in political elections when, *ceteris paribus*, voters favour a party or candidate that is perceived as a likely winner (i.e. doing well in the polls) before election day. The underdog effect, on the other hand, states that the perceived losing candidate receives increased support by the voters (Simon 1954). These effects are related to the optimism/wishful thinking bias, as they both deal with the preference-expectation link. The bandwagon and underdog effects, though, claim that preferences are influenced by expectations, and not the other way round, as is the case with the wishful thinking bias (Krizan et al. 2010). As such, both the bandwagon and the underdog effects fall under what we may call *expectation effects* on political preferences.

There is widespread popular belief that expectation effects do exist. They have been used as explanations for erroneous poll projections (McAllister and Studlar 1991), resulting in pollsters being banned from publishing poll rates during the

⁵ The name originates from circus processions, where people would in emotional excitement flock behind the bandwagon playing music while rolling through the streets. The psychological mechanism is the enthusiasm and desire to be part of the crowd (Hardmeier 2008)

final days of election campaigns in countries such as France and Switzerland.⁶ Some research supports this belief (McAllister and Studlar 1991; Nadeau et al. 1994), but the main message from the literature as of today is that empirical evidence of any such effect is weak (Krizan et al. 2010; Fuchs 1966; Mendelsohn 1966; Tuchman and Coffin 1971; Sonck and Loosveldt 2010; Hardmeier and Roth 2001; Hardmeier 2008). Nevertheless, the potential for expectation effects are characteristics that make social science predictions more complex than natural science predictions. A scientist is ideally a person who analyses the world from the outside, but a social scientist is part of the object he studies, and the study objects are also able to react on the analyses the social scientist makes (Skjervheim 1957). Once a prediction of an election has become public, it becomes part of the information material which the voters may utilize when making their vote decision.

Both economic vote forecasting models and prediction markets are susceptible to expectation effects, but when it comes to forming expectations they are quite different from each other. Table 1 (on page 22) shows that the economic vote models fall neatly into the Keynesian tradition in forming expectations. Likewise, prediction markets are based on the fundamental market principles laid out by Hayek.

If we follow Hayek's argument, prediction markets represent the "less scientific" method and more accurately represent the real world, however at the expense of not knowing the justification for the predictions. Similarly, the vote forecasting models are explicitly expressing the predictors and their impact on the aggregate vote, but perhaps at the cost of excessively taming the complex task of predicting the voters' choices at the polls. Vote model forecasts assume mechanical reactions by the voters to objective measures of economic and political variables. However,

⁶ In the recent Swiss national elections, the Gfs polling agency was blamed by representatives of the Schweizerische Volkspartei (SVP) for their disappointing result in the election (Mooser 2011)

when conducting such a delicate and complex task of forecasting aggregate election outcomes with a decimal's precision, any successful method needs to be able to fine-tune its expectations by accounting for the specific context in which the upcoming election takes place. In the aftermath of the 2008 US presidential election, Campbell (2011:2) says that "the assumption for the forecasting models is that there are *no unexpected and major politically charged events that intervene between the time of the forecast and the time of the election that derail the normal playing out of the fundamentals.*" As Campbell writes, such incidents are rare, but they do occur every now and then. As we will see in the US prediction market article, the market participants are well equipped to adjust to abrupt preference changes among the electorate. When the Lehman Brothers collapse occurred on 16 September 2008, the traders at the Iowa Electronic Markets quickly realized the political implications of this event. The vote share percentage of John McCain was traded down to the mid-40s, a level from which he never recovered. Interestingly, then, the conclusion from the analysis of the prediction market feeds back on the main message from the economic voting literature: citizen dissatisfaction with national economic performance decreases the chances of a vote for the incumbent.

So, which method is better for election prediction? Only sporadic attempts have been carried out comparing vote forecasting models and market predictions, but the few studies that have been conducted suggest that prediction markets have a slight edge on vote forecasting models (Cuzán et al. (2011); Arnesen (2005); Leigh and Wolfers (2006)). More studies have been done comparing prediction markets with poll projections, and I will now turn my attention to these.

Polls as benchmarks

Those who make forecasts usually assess their performance relative to polls (Forsythe et al. 1992) because polls dominate election campaigns. Worcester (1996) stresses that polls are snapshots of the voters' political preferences and

not prediction instruments, nevertheless they are used for that purpose by the media, scholars, and the industry itself (Berg et al. 2003; Buchanan 1986; Traugott 2001). Historically, prediction markets have been more accurate than polls. Displaying Iowa Electronic Market results from 237 contracts in 49 markets from 13 countries, Berg, Forsythe, Nelson, and Rietz (2008a) find that the average market error for all the predictions was 1.49 per cent when measuring election eve closing prices. The corresponding poll error was 1.91 per cent. High profile election markets with large volumes and few contracts, such as the US presidential elections, tend to perform better (Berg et al. 1996). Berg, Nelson, and Rietz (2008b) present an analysis of the long-run forecasting ability of markets relative to polls for the US presidential elections from 1988 through 2004. For the final 100 days of the election campaigns, the market predictions were closer to the election results on 74 per cent of the days. Concerns about the possibility of manipulation of predictions have arisen (Hansen et al. 2004), but such attempts at manipulation have been largely unsuccessful in the long run (Hanson et al. 2006; Hanson and Oprea 2009; Wolfers and Zitzewitz 2004; Rhode and Strumpf 2008).

While intuitively one might suspect that market predictions follow poll standings, this is not supported empirically. Certainly traders will use the information from polls when trading, but they are only one of the considerations the traders take into account when making predictions. If anything, say Forsythe, Nelson, Neumann, and Wright (1992), market prices predict changes in polls. But how can prediction markets be more accurate than polls when polls ask a representative group of citizens about their vote intentions?

Pollsters typically give the respondents this question: "If the elections were held today, who would you vote for?" If the question is meant to serve as a measure of how the voters are going to act on Election Day, there are at least two potential sources of error: The voters may change their minds between the time of the

survey and the time of the election, and they know that the question is hypothetical and not actual. Regarding the first point, respondents in polls tend to be sensitive to issues which, on the day of the poll, are high on the agenda in the media and among citizens, but which on the day of election may be largely forgotten. The *convention bounce* phenomenon in US presidential campaigns is one such example, where the party holding the convention sees a rise in support during the convention, only to witness it drop back to previous levels after it has ended (Berg et al. 2003).

The second point is that a respondent may – knowingly or unknowingly – not give out the same political preference in a survey as in the election. She might want to conceal her real political preference, or perhaps she wants to use her voice in the poll to express dissatisfaction with her party. Her dissatisfaction may not be so strong that she actually will vote for another party on election day because then she will have to live with her decision for the entire election period. Changing her party preference in a survey, on the other hand, has fewer consequences and might serve as an early warning to her preferred party. Nannestad and Paldam (1994:229) argue that it is easier and less risky to send a signal to politicians via opinion polls than elections, and that the vote, therefore, has “more the character of a *deliberate choice*, while a poll reflects *gut feelings*.”

Then there is the issue of rational ignorance. Downs (1957) claimed that there is no rational reason for people to stay informed about politics, as their vote in all likelihood will not have a decisive impact on the outcome of an election. Some citizens, however, may want to stay informed for other reasons, such as out of political interest or out of a desire to be knowledgeable about decision making processes. As a result, citizens can be divided into two groups – those who are well-informed about politics and those who are not. The large majority of voters, said Converse (1964), are uninformed about (and disinterested in) politics, and have a tendency to frequently change their stated opinions. When pollsters ask a

representative group of voters, then, they are likely to meet respondents without consistent political preferences. The consequence is a volatile and inconsistent output of poll ratings. Traders in a prediction market, on the other hand, are almost by definition likely to come from the well-informed group of citizens. By self-selecting as participants, they signal an interest in politics that poll respondents have not necessarily signalled. They must put their money where their mouths are and need to stay updated on the political scene to have a chance at outperforming the other traders in the market. Hence, while the polls, to a large degree, consist of rationally ignorant respondents, prediction market participants have a uniform rational incentive to stay informed, which gives the markets an edge over polls.

Not everyone buys the argument that polls cannot predict election outcomes as accurately as prediction markets, though. Erikson and Wlezien (2008) contend that one may model the poll volatility and adjust the projections accordingly. The polls may be volatile and inaccurate, but they are so in a predictable manner, and if this is accounted for, the polls will become even more accurate than market predictions. In the article, they have sampled polls from American presidential elections in the years between 1952 and 2004 and regressed poll standings on the actual election outcome in separate equations for each of the last 200 days prior to election day. The polls outperform both the vote share and the winner-takes-all predictions from the Iowa Electronic Markets.

Wlezien and Erikson's paper is intriguing and challenges the now established notion that prediction markets are superior to polls as an election forecasting method. Considerable insights can be drawn from their analysis, and their finding that the voters' movements are so predictable across time is very interesting. The critique of the article is perhaps that in the effort to compare polls and prediction markets on a level playing field, they instead tilted it in favour of the polls. Comparing *ex post* poll predictions with *ex ante* market predictions is not a fair

exercise, in my opinion. When the election result is clear, it is easier to make forecast models that fit the real world than if the forecast is made for an unknown future outcome. To put the model to the ultimate test, the enhanced polls should be used to make an *ex ante* forecast - or rather a series of forecasts - of the next upcoming election.

They do, though, have a point. Polls in the United States are always published as raw polls, and refinements of the polls by taking actual election results into consideration will make the polls more finely tuned as forecasting devices. Actually, the United States is, in this regard, an exception; to my knowledge most European pollsters do bake the raw numbers before they publish them. After the failure in 1948 to predict Truman as the winner over Dewey in the US presidential election, the American pollsters have followed the recommendations from Mosteller's (1949) report only to publish the raw polls. In other countries, such as Norway, pollsters adjust the raw polls before publishing, each with their own secret formulas. This could potentially make these polls better at predicting election outcomes.

The method of aggregating opinions through a prediction market design also faces other pitfalls. As Sunstein (2006) discusses, the critique of the efficient market hypothesis from behavioural finance applies to prediction markets as well. Markets are not always efficient and face threats of traders' biases and attempts at manipulation. What is more, the design of the prediction market is likely to affect how accurate it can be (Bergfjord 2011). Prediction markets vary with respect to size, composition of traders, whether they use real money or play money, contract design, and more. Building on the existing literature, the Norwegian prediction market article addresses some of these issues.

Norwegian prediction market experiment 2009

One of the motivations behind the internet experiment was to test the method on a new polity. Would prediction markets be as accurate here as they historically have been in two-party contests in the United States? In prediction market trials from four Dutch elections, Jacobsen et al. (2000) found the market predictions to be less accurate than those in the US. They considered a number of reasons and preliminarily concluded that the reason might have been that traders have a harder task in trying to predict voter movements when there are more than two alternatives, as seen in the Dutch multiparty system.

Motivated by the desire to test for the first time how well prediction markets perform in Norwegian politics, I created prediction market software so I could conduct a field experiment before the 2009 Norwegian parliamentary election. We can refer to the article for a description of the set-up, but the main conclusion of my article was that in Norway, as in the US, the market predictions were more accurate than comparable poll projections. During the 40 days of the trial period, the prediction markets were more accurate than polls in 88 per cent of the daily observations. On average, their mean absolute percentage error was 1.2 percentage points off of the election outcome, compared to 2.1 percentage points for the polls. Hence, from these results it seems that prediction markets are as accurate in Norway as they are in the US.

Another question which comes up frequently in relation to prediction markets is whether real-money markets are more accurate than play-money markets (Servan-Schreiber et al. 2004; Rosenbloom and Notz 2006; Luckner and Weinhardt 2007). A related question to this is whether or not monetary incentives serve as better motivators for traders than non-monetary incentives do. As discussed in Jacobs (2009), Read (2005) argues that non-monetary incentives can be as good a motivator for experiments as money can be. People can do many things for free if they have an intrinsic motivation for their actions (Gneezy and Rustichini 2000). However, if they receive payment, this intrinsic

motivation is replaced with an extrinsic motivation. If the payment then is not sufficiently high, it will not compensate for the loss of the intrinsic motivation, and the consequence of introducing monetary incentives may be counterproductive. In the trials for the 2009 Norwegian elections, we let some groups of traders trade with NOK 200 each, while the others were using play-money. The groups with play-money were however all active party members, so their loss of extrinsic motivation could possibly be compensated with an intrinsic motivation of staying informed about the election campaign and the winning chances of their own party. Measured as number of trades during the trials, we did however find that the groups with a monetary incentive were more active than the other ones.

The final question considered in the trials was the relationship between preferences and expectations. One of the most robust findings in social psychology is that expectations are positively linked to preferences. That is, people tend to have overly optimistic expectations about their preferred party's chances in the election (Cantril 1938; Granberg and Brent 1983; Krizan et al. 2010). This is known as *optimism bias* or *wishful thinking effect*. In our case it suggests that traders in the prediction market will inflate the expectations of their preferred candidate or party. On the other hand, Nadeau, Niemi, and Amato (1994) found that respondents' preferences synchronize well with expectations, and Babad (1997) demonstrated that the wishful thinking bias was lower among those who were given monetary incentives for accurate predictions of a 1993 Jerusalem mayoral election. One study of the Iowa Electronic Markets traders showed that the traders in the market were far from representative of US voters (Forsythe et al. 1992). The typical trader was male, well-off, voted Republican, and was more politically active than the average citizen. They also show that the majority of the traders did indeed suffer from a wishful thinking bias, but despite this the markets still performed well. Jacobsen et al. (2000) also found that traders back up their political preferences by trading in the market, but without

detecting any impact on the price formation in the market. This fact is explained with the *marginal trader hypothesis*, which claims that there will always be some rational traders who correct the biases of the average trader once they have moved the price away from equilibrium. Markets seem to meet or beat competing institutions in part because of the disproportionate influence such markets give to rational and informed traders (Hanson forthcoming). They will correct the biased, incorrect predictions, and make a profit from it. So, if we take this idea to its natural conclusion, we might ask if a group of active party members will be able to predict their own election result in a prediction market. Will the market design be able to cancel out the anticipated wishful thinking effect, or will such a skewed group of traders make the market predictions overly optimistic regarding their own party? This was the motivation for organizing separate groups of traders consisting solely of active party members in the 2009 Norwegian election trials in addition to groups with “regular” participants. As the article reveals, one of the party member groups made very accurate predictions, but the other fared poorly, so the results are inconclusive. There were, however, indications that optimism bias the groups of active party members were more optimistic on their own parties’ behalf than the regular groups were.

All in all, there are still a number of questions to address with regards to how the design of prediction markets affects their accuracy, and the 2009 Norwegian pioneer trials make only small steps in addressing some of the questions that need attention. The field has received a growing level of scholarly attention since the turn of the century (Tziralis and Tatsiopoulos 2007), but it is still a young discipline with a number of open questions (Wolfers and Zitzewitz 2006). Next, I discuss how prediction markets can be relevant to political science, and present existing political science studies – including my US prediction market article – that have made use of prediction market data.

Relevance to political science

Can we really infer anything about the voters based on a series of predictions made by a self-selected crowd of traders – a crowd that is far from being representative of the voters as a whole? What are the implications of changes in market predictions? What does change signify, other than the fact that a group of people has changed its opinion about the outcome?

In an ideal world, an election would take place every day, all year, every year, and all of the votes would be monitored and linked to each citizen so that we would know for sure whether she voted and for which party. In reality, we will have to settle for what are only remote approximations of full information about the vote. The act of voting is and must be a secret, and it only takes place once every few years. Given these restrictions, there are some choices to make when approaching the questions of voting behaviour. One way is to analyze real election outcomes, thereby accepting the limits of aggregate data and the low frequency of elections. Another option is to simulate an election, and by doing so to increase election frequency. Needless to say, a simulated election is not the real thing, and some compromises will have to be made with regards to the validity of the data. If we regard an opinion poll as a simulated election, we compromise by including just a sample of the voters, by accepting that the respondents may respond untruthfully or disinterestedly, and by acknowledging that the respondents may not regard the survey as a simulated election, but rather as an opportunity to voice their apprehension of the political actors in a less consequential situation than what a real election represents. Another way of simulating the election is by organizing a prediction market in which traders exchange contracts of political parties or candidates, and where the price of the contracts depends on the expected pay-off from the upcoming election result. The compromise we make with this approach is that we rely on the judgments from a small number of people about how the electorate as a whole will vote. These traders do not *represent* the voters as respondents in a survey do, but they *interpret* the voters and *anticipate* their behaviour. They have a manifest interest in the question they are contemplating,

and are motivated by monetary incentives or a general desire to test their abilities to predict the election outcome. Under their own volition, the traders have decided to participate in the prediction market. Whatever their motivation, they will reap their reward by doing well in the market. To do well in the market means to be able to predict the outcome accurately.

Contrary to opinion polls, the usefulness of prediction markets stand and fall on the question of accuracy. Opinion polls do not need to predict the outcome correctly as long as they measure the opinion of the citizens correctly. If polls measure the citizens' opinions correctly but fail to predict the outcome accurately, this only means that polls are different from elections and not suitable as prediction instruments. What the citizens state in the poll is still interesting in its own right, as it serves as a channel of communication from the citizens to the people they have chosen to represent them in political positions. This is not so with the prediction markets. If they are inaccurate, the judgments of the traders become irrelevant. If they *are* accurate, though, the question of representativity becomes irrelevant since they have shown the capability to predicting the actions of all voters in terms of aggregate outcomes. Now, the accuracy of all the daily hypothetical elections in the market must be measured against the actual outcome on election day at some later point in time. As displayed earlier, their predictions have been more accurate than polls. Bear in mind, though, that there is no way to know for certain whether or not the market prediction was a correct representation of the voters' intentions on that very day. We only know whether or not it was accurate in relation to the election outcome several days or weeks later. On this matter we must *assume* that if market predictions prove to be accurate in predicting the outcome, they are also accurate anticipations of the vote on any given day in the election campaign. Given this reservation, prediction markets produce high frequency time series data with which one can study price movements in relation to other variables. The studies that have utilized

prediction markets for research are presented below, including my article on the US prediction market.

Prediction market studies in political science

While it is widely established that the economy influences election outcomes, it has been claimed that the opposite also occurs (Alesina et al. 1997). Arguing that an implication of this theory is that changes in election probabilities generate shocks to expectations about macroeconomic policy, Snowberg, Wolfers, and Zitzewitz (2007) use prediction markets to test this hypothesis by tracking the election day winner-take-all prices from the 2004 US presidential election and comparing them with financial markets on the same day. Both prediction markets and financial markets constitute high frequency time series data sets, thereby allowing a high number of observations to be compared within a period of one day. At ten- and thirty-minute intervals, they discover that the probability of Bush winning the election was positively correlated with changes in expected equity and oil prices, while negatively correlated with bond yields.⁷ These findings suggest that the markets believe it does matter who takes office, and that macroeconomic policies will differ depending on who occupies the White House over the coming four years. In a different paper, Snowberg, Wolfers, and Zitzewitz (2006) find similar patterns for Congressional majorities, although the effect on the financial markets is smaller than that of the presidency. Also, Malhotra and Snowberg (2011) use market predictions to reveal that states with early primaries have a disproportionately large influence on the nomination process of US presidential candidates. Among others, Wolfers and Zitzewitz (2009) and Berg and Rietz (2003) suggest that prediction markets can be used to inform political decision makers by speculating on outcomes conditioned on the decision makers' actions.

⁷ The negative relationship with bond yields is explained with the fact that the Republican presidents have been the biggest public spenders since the 1980s.

In the US prediction market article, I apply prediction markets to test the impact that selected events have on voter trends during election campaigns. The theoretical framework is based on an article by Gelman and King (1993), where they ask why pre-election polls are so volatile when the vote is so predictable. Their baseline argument is that the polls represent the process in which the voters gradually become aware of the fundamentals which determine their political preferences. As election day approaches, the voters become increasingly interested in political matters and the media feeds them with updated political information. As a consequence, the polls get less volatile and more accurate as election day approaches. Based on the efficient market hypothesis, Kou and Sobel (2004) argue that prediction markets should incorporate all known, relevant information. Therefore, the enlightening process that the voters undergo ought to be accounted for in the market predictions. Hence, I call the market predictions a representation of an “enlightened process”, that is, a process which is stripped of the “noise” that opinion polls contain. For those interested in analyzing the various impacts that campaign events or process have on the vote, market predictions represent a new and appealing supplement to opinion polls. The article is a first attempt in utilizing this innovation to explain voter trends during 2004 and 2008 US presidential election campaigns. The study finds that in the two elections, only the Lehman Brothers collapse in 2008 had a significant impact on the vote. It reinforces the existing literature on economic voting, as the candidate of the incumbent party was punished for a negative economic shock. Once the collapse was a fact and the citizens realized its magnitude, the voters reacted as one would expect from a retrospective voter: They voted for a change of the governing party.

While the Lehman Brothers collapse was an *enlightened* event, the Swift Boat Veterans for Truth ad campaign in 2004 was an *enlightening* event. The attempt at discrediting the Purple Heart that John Kerry received during the Vietnam War was successful with the poll respondents. When the ad campaign started, George

W. Bush climbed in the poll ratings to gain the lead, never to fall back to his pre-swift boat level. Interestingly, the ratings climbed up to the level where the prediction markets had been laying stably both before and after the ad campaign was initiated. It therefore seems as if the swift boat ads released an untapped potential for Bush. Again, the expectations of the market traders concur with the knowledge from the field of economic voting: In 2004, Bush was both an incumbent standing for re-election as well as a war-time president, which were two important factors suggesting he would win over his opponent.

In summary, this chapter has debated over how information and expectations about election outcomes relate to each other. There are alternative approaches to collecting and processing information, each with its strengths and weaknesses. The economic vote forecasting models make explicit models that clearly state the anticipated causes of the election outcome – causes that on a general level are thought to be valid across time and space. The generality of the models might come at a cost of being less fine-tuned for making predictions about any particular election.

Opinion polls always provide valuable information to the public, namely what the citizens currently think of their political representatives. What the citizens signal in polls does not, however, always translate directly into how the voters will behave on election day.

So far, a prediction market seems to be the mechanism that forms the most accurate expectation about future election outcomes, and it is for this reason that they are of interest to political science. The market traders are not representative of the voting population, and they do not give arguments for their predictions. As such, they cannot replace the position in society and academia held by poll surveys or economic vote models. They do, however, constitute a relevant supplement not only for the general public who take an interest in qualified

speculation about forthcoming elections, but also for political scientists who study causes and effects of election outcomes.

Method and Data

In this section I will discuss the data collection process and the methods applied in the analyses. As displayed in Table 1 in the introduction, two of the dissertation articles analyze time series data, while one article bases the analysis on data from an internet experiment.

The economic voting and the US prediction markets articles

The data used in the US prediction market article is secondary data retrieved from the internet. As described in the article, the market predictions are openly available at the Iowa Electronic Markets website.⁸ The poll data were downloaded from pollingreport.com (2004 election) and realclearpolitics.com (2008 election). As for the economic voting article, all data are secondary and also retrieved mainly from the internet. The exception is some of the early economic data, which were drawn from Statistics Norway's *Historical Statistics (1995)*

In the two articles in question, I analyze time series data. The economic voting article on Norway analyzes sequentially-ordered election outcomes for the left bloc parties during the period of 1945 to 2009, while the US prediction market article analyzes the impact of selected events on the poll ratings and market predictions of the Democratic and Republican candidates for the 2004 and 2008 US presidential elections. Below, I elaborate on the characteristics of time series analyses.

Time is, like space, a dimension for variation that allows us to study the causes and consequences of events, opinions, and behaviour. When compared to cross-sectional data, time series data is still much less used in political science. In recent years, however, there has been a dramatic increase in the availability of a wide

⁸ <http://tippie.uiowa.edu/iem/index.cfm>

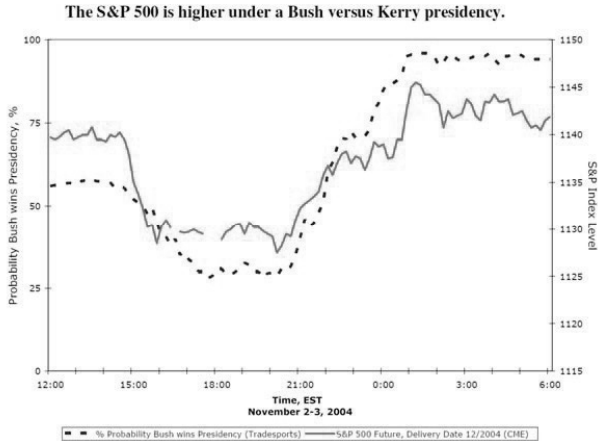
range of sequentially-ordered data, and with it a rise in scholarly interest in time series analysis techniques (De Boef and Keele 2008). A central advantage of time series is that one is better able to identify causal mechanisms, as the cause tends to be observed before the effect (though not always).

A time series may be defined as a collection of data X_t ($t=1,2,\dots,T$), where the interval between the units is constant (Ostrom 1990:5). Time series data are stochastic, meaning that the values are random, and the observations are thought of as realizations of the underlying stochastic process. Where the order of cross-sectional data normally is irrelevant for the analysis, time series data must appear in an ordered sequence. It is not only the value of the observation but also its placement in the series that is important, as their values tend to depend on the values of previous observations that are proximate in time (Midtbø 2000). This time dependency is at the core of time series analysis, as it is the one characteristic that most distinctively separates it from cross-sectional data.⁹

The frequencies of observations may vary greatly from one series to another. In the economic voting article on Norway, there are two years in between each observation of the left bloc's vote share, while Snowberg, Wolfers, and Zitzewitz (2007) analyzed observations at ten minute intervals when studying relationships between prediction market prices and financial market index levels (see figures 2 and 3). What is important is that the interval between the observations in a series is constant.

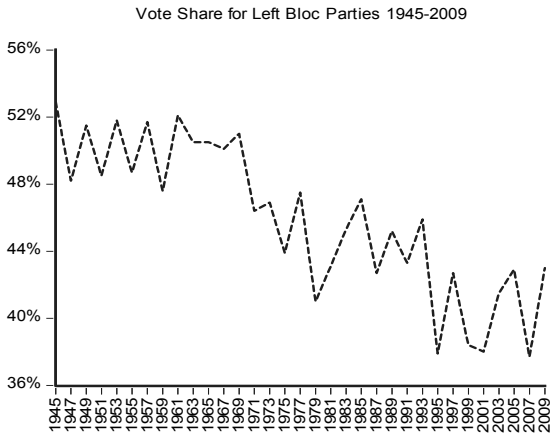
⁹ Spatial autocorrelation, however, also occurs in cross-sectional data.

Figure 2: S&P 500 index and Tradesports' probability that George Bush wins 2004 US presidential election



Source: Snowberg et al. (2007:Figure1)

Figure 3: Vote share for Norwegian left bloc parties 1945-2009

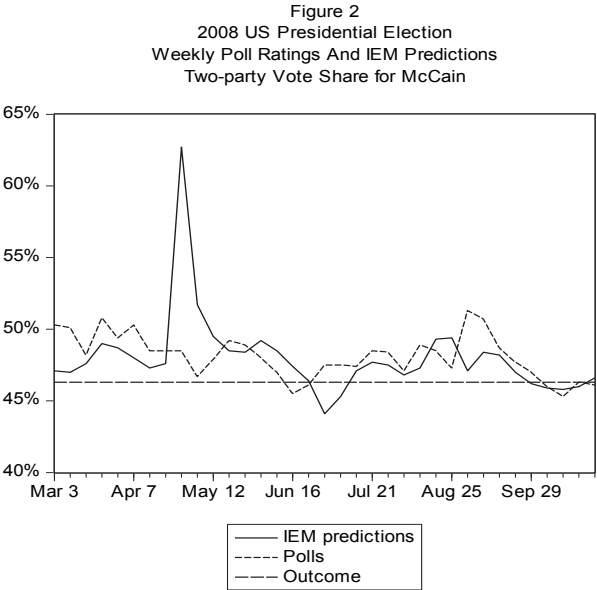


Source: Arnesen (2011b:Figure 1)

Any time series analysis should start with a visual observation of the series. Is there any sign of a time-dependent trend in the data, seasonal variations, extreme observations, or perhaps crucial break points? The dynamics of the series must

be followed up by statistical techniques, but often a time series plot can reveal important characteristics of the series. Figure 4 displays the weekly aggregated poll ratings and IEM vote share predictions for John McCain during the 2008 US election campaign. The graph clearly identifies an extreme observation in the series during the final week of April. An extreme observation such as this one will disproportionately affect the statistical analysis. Hence, in the article I model this observation as a separate dummy variable that takes the value of 1 at the time of observation and 0 otherwise.

Figure 4: Weekly poll ratings and IEM predictions for Republican candidate John McCain in the 2008 US presidential election



Source: Arnesen (2011a:Figure 2)

In political science and elsewhere, a main issue of concern with time series is what is known as non-stationarity (Clarke and Stewart 1994; DeBoef and Granato 1997). If a series is non-stationary, it will not have a constant mean or variance, which is a prerequisite for the reliability of the t-ratios that are used for

hypothesis testing. As a result, the normal tests of statistical significance do not hold. In their article *Spurious Regressions in Econometrics*, Granger and Newbold (1974) showed that by generating two non-stationary random walk sequences with no relation to each other, they were nonetheless able to reject the null hypotheses of no relation three out of four times (at 5 per cent significance level).

A typical example of a non-stationary series is inflation: Prices steadily increase and rarely return to their previous price levels. If two such series are analyzed together, they may seem to be strongly and positively related when using ordinary least squares (OLS) techniques. The reality may, however, be that the only feature they share is continuous growth. A curious example taken from Midtbø (2000) shows how the increasing number of social science students over the years in Norway “causes” the rise in prison inmates during the same period. Clearly this is an example of a nonsensical regression, but in other instances the mistake might not be that easy to spot.

Therefore, a lot of attention has been given to the potential remedies of non-stationary series – also known as integrated series or series with a unit root (Enders 2004). The quickest fix is to difference the data: that is, to analyze the change in values from one observation to the next rather than their absolute levels. In social science, virtually all time series will then become stationary. However, there is increasing concern that this approach swings the pendulum too far, where the series becomes “over-differenced”. In a time series, over-differencing is a problem because any trend in the data will have been wiped out, and true long-term relationships between the variables may not be uncovered. Sometimes differencing the series is inevitable, but the remedy should not be applied indiscriminately.

There are a number of techniques whose aim is to characterize time series dynamics and the endogenous relationships between the time series (Brandt and Williams 2007). Autoregressive integrated moving average models (ARIMA),

simultaneous equation modelling (SEQ), vector autoregression models (VAR), autoregressive distributed lag models (ADL), and error correction models (ECM) are all dynamic models concerned with how previous observations influence the value of current observations. As Brandt and Williams (2007:4) note, the difference between them has less to do with *technique* and more to do with *approach*.

ARIMA models originally stem from industrial engineering. These models approach the time dependency issue by “pre-whitening” the series before they are analyzed in relation to other variables (Beck 1991a). They do so by identifying time dependent processes such as autoregressive components, integrated series, and moving averages (McCleary and Hay 1980). According to Beck (1991a), they are more data-driven and well suited for intervention analyses such as the impact that an outbreak of war has on approval ratings.¹⁰ For multivariate analyses they may become complicated to use, and the tool kits used are also unique to these models. The VAR models also let the data speak for themselves by not identifying endogenous and exogenous variables before their relationships are investigated empirically. Simultaneous equation models start out with a single theory or approach and render it into a set of equations (Brandt and Williams 2007). The error correction models are a specialized case of ARIMA regression and simultaneous equation models, and applies to any model that directly estimates the rate at which Y_t changes to return to equilibrium after a change in X_t (De Boef and Keel 2008). The advantage with ECM is that it preserves the long-term relationship between the variables by allowing lagged values of the independent variable to be included within the equation, even if the dependent variable is differenced (i.e. changes in Y_t are analyzed rather than levels of Y_t). The same can be said about the ADL models, and they are in most respects similar to ECM (De Boef and Keele 2008). Beck (1991a) compares some of these models and states that, mathematically, none of them are better than the others for

¹⁰ See for instance Clarke, Mishler, and Whiteley’s (1990) analysis of the influence that the Falklands War had on Margaret Thatcher’s ratings.

analyzing political approval data. However, the political science literature on time series seems to favour ECM or ADL. I employed a restricted ADL model in my two articles.

In a general ADL ($p, q; n$) model with no restrictions, p refers to the lags of the dependent variable Y_t , q refers to the lags of the independent variables, and n refers to the number of independent variables. A general ADL (1, 1; 1) model then is expressed as

$$Y_t = \alpha_0 + \alpha_1 Y_{t-1} + \beta_0 X_t + \beta_1 X_{t-1} + \varepsilon_t \quad (1)$$

where Y_t is the dependent variable, α is a constant, Y_{t-1} is the lagged dependent variable at time $t-1$, X_t is the independent variable, X_{t-1} is the independent variable lagged at time $t-1$, and ε_t is the error term. If Y_t is the annual presidential approval rating and X_t is a measure of unemployment, then β_0 tells us how the current unemployment level affects the approval ratings for the same year, while β_1 shows how the unemployment numbers from last year influence the approval ratings for this year.

From this general model one may restrict the model in several ways, for example by making the model static ($\alpha_1 = \beta_1 = 0$), differenced ($\alpha_1 = 1, \beta_0 = -\beta_1$), or partially adjusted ($\beta_1 = 0$). In the US prediction market article and in the article on economic voting in Norway, I used a partially adjusted model:

$$Y_t = \alpha_0 + \alpha_1 Y_{t-1} + \beta_0 X_t + \varepsilon_t \quad (2)$$

The time dependency has thus been modelled as autoregressive at one lag, which means that the effect of Y_{t-1} persists for all future values of Y_{t+k} , but at an exponentially diminishing rate. This means that previous observations of the dependent variable are sticky, but in practice virtually evaporate after a few

observations. There are many ways to model time dependency, but using partial adjustment models is quite common in political approval data.

The Norwegian prediction market article

The Norwegian prediction market article analyzes the data generated from an internet experiment I conducted in relation to the 2009 Norwegian parliamentary election. Morton and Williams (2010:42) define an experiments to occur “when a researcher intervenes in the [data generating process] by purposely manipulating elements of the [data generating process]”. An internet experiment is an “experiment in which the subjects’ interaction with the experimenter or other subjects is largely via the internet” (Morton and Williams 2010:280). As the authors discuss, an internet experiment is somewhere in between a field experiment and lab experiment. Field experiments are characterized by a lower ability than lab experiments to control observable and non-observable confounding factors that may interfere with the researcher’s ability to draw causal inferences from the experiment. At the same time, they are closer to real-world situations than lab experiments are.

Experimental research can be said to take place in three stages: Design, data, analysis. The design and analysis is discussed in the Norwegian prediction market article, and here I will focus on some elements of the data generating process that the word limits of the article did not allow me to elaborate on in the article, namely how the prediction market data was generated.

The market predictions consist of primary data generated from the software that was created for the experiment. In order to conduct trials with prediction markets in Norway, it was necessary to create software almost from scratch. ¹¹

¹¹ Regarding the polls that were analyzed in the article, they were retrieved from the television channel TV2’s *Partibarometer*. Link as of November 24, 2011:

Making and using the prediction market software

Obtaining the data necessitated a web-based programme. Initially the aim of the experiment was to couple the largest international prediction market at that time – Intrade – with the Norwegian financial newspaper Dagens Næringsliv. In turn, the researcher would be able to gain access to the data that would come out of cooperation between them. It seemed like a good fit, as Intrade was interested in gaining Scandinavian exposure, and Dagens Næringsliv was interested in a prediction market with the capability of drawing attention to the newspaper and generating traffic. After a couple of meetings in Oslo with the development department of the newspaper, it seemed as if we were reaching an agreement. The deal was, however, based on the assumption that we would be able to permit the participants to stake their own money in the prediction market, but this would not come to pass. On July 7, 2008 the Norwegian gambling authorities, Lotteritilsynet, after conferring with the Ministry of Culture and Church Affairs, rejected our application to exempt our experiment from the gambling laws. Without the involvement of real money, Intrade demanded a price for organizing the prediction market that was far beyond the reach of my resources for the project.

Realizing the risk that the election would pass without any prediction market experiment in place, I considered a second option. Zocalo is an open source prediction market platform, constructed and maintained by Chris Hibbert (2005).¹² Working full time with the Zocalo project, Hibbert had continually improved the platform. However, at the time when I needed it, there was still quite a bit of programming that had to be done to adapt it to the Norwegian election contest. Hibbert was not able to get involved in the experiment, and therefore this option was abandoned in the initial phase.

<http://www.tv2.no/nyheter/innenriks/politikk/valg09/partibarometeret-2677103.html>

¹² <http://zocalo.sourceforge.net/>

The third option would be to take full control of the programming. This approach involved the most work, but also let me control the whole process so that I was certain to make the deadline for the election campaign. Given that, I decided to go ahead with it. Before starting the PhD, I had been engaged in starting up Predimark, a company specializing in prediction markets. After starting the PhD, the company went into hibernation, but the programmes were still there. In a deal with Predimark, it was agreed that I could use the programme for free if I myself paid for its adaption to the experiment. Kjetil Thuen from Evolver DA was engaged in programming, and Kjetil Ravnås from Gnosis was in charge of the visual design. I would lead the development of the programme myself so that it reached the standards I had set for the programme.

A couple of key decisions had to be made with the programme. Should we use a continuous double auction or an automated market maker? Furthermore, if we use an automated market maker, which one should we use? In what follows, I will discuss these options.

The market maker

The first experiments with prediction markets were conducted before the internet had made its breakthrough. The organizers of the Iowa Electronic Markets would set up a call market with Iowa University students, where the students could phone the organizers to make trades that were processed in bulk. When internet-connected computers took over as communication media, the market was set up as a continuous double auction, which means that the traders would bid or ask prices, and whenever there was a match with another participant, a trade would go through. This set-up is similar to stock markets and betting exchanges, where the traders both offer and accept prices. A continuous double auction appeals to operators of real-money markets, as it poses no financial risk to the organizer (Spann and Skiera 2003). The disadvantage is that many traders are less willing to accept prices than to offer them, resulting in an

imbalance between supply and demand. The reason for this is that the traders who offer prices have a time disadvantage, as those who accept the price get to choose the timing of the trade. So, while the price offered might have been correct at the time it was put up, the situation might have changed over time, and suddenly the offer might seem very generous to the price taker. The party offering the price must therefore always be on the alert to new information, and this demands more effort from the trader. As a consequence, there is always an imbalance between the number of price taking traders and price “making” traders, the so-called market makers. The *thin market problem* occurs when few traders care to participate since there are so few other traders, which in the long run leads to the breakdown of the market (Pennock and Sami 2007). Markets with few traders – a typical situation in election prediction markets – are particularly vulnerable because this leads to low liquidity and few trades in the market (Hanson 2003). The Iowa Electronic Market still uses a continuous double auction, however most other organizers prefer to implement an automated market maker into their programme.

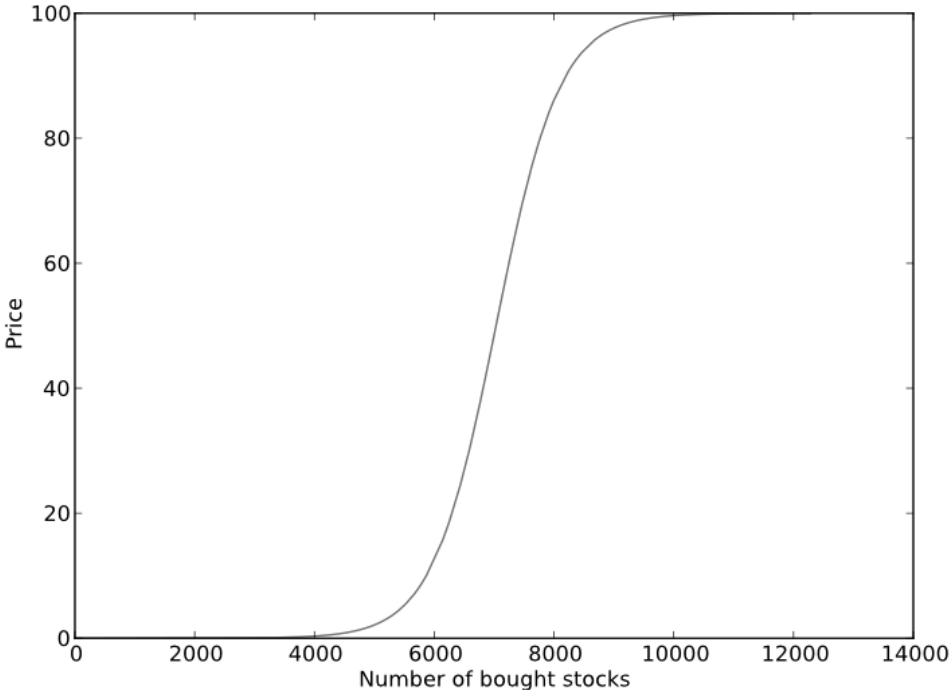
An automated market maker is an algorithm that automatically offers a new price for the contract after a trade has been made. The organizer then ensures there is a price offer for any trader to take at any time. The obvious benefit is that the liquidity in the market is infinite. One disadvantage is that, in effect, the organizers involve themselves in the price setting and thus expose themselves to monetary risks if the market uses real money. When considering the pros and cons regarding the trials we were making the software for, we were more concerned with low liquidity than with financial risk. Recruiting a sufficient number of volunteers for the trials to be conducted with continuous double auction procedures would be a greater obstacle to overcome than using an automated market maker and risk paying out a marginally greater sum of money than anticipated. Of greater concern is to what degree an automated market maker impedes the traders’ abilities to express their real expectations of the

election outcome in the market (Pennock and Sami 2007). It is evident that it does because it mechanically calculates new price offers according to the number of contracts that are being bought and sold.

There were two alternative market makers to consider: the dynamic pari-mutuel market maker developed by David Pennock and the logarithmic market scoring rule developed by Robin Hanson. Dynamic pari-mutuel markets combine the characteristics of the aforementioned continuous double auction and pari-mutuel markets (Pennock 2004). Pari-mutuel markets are common in horse race betting, where the punters pick a horse and, in the event of a win, share any winnings with other punters who bet on the same horse. No matching with other traders is necessary, which allows for infinite liquidity. Also, the organizer faces no monetary risk since only the money that the traders put in will be redistributed back to the winners. The significant drawback with this market maker, however, is that the traders do not know how much they will win at the time they stake their money. New traders may jump in at a later stage, and the pool of money will have to be shared with more people. Hence, there is no incentive for traders to take a position until the very last minute of trading.

The logarithmic market scoring rule invented by Robin Hanson (2003) has become the most popular automated market maker among prediction market organizers. The reason for this is its simple yet proper design. Sliding on a logarithmic scale between 0 and 100, Hanson's scoring rule works like a two-sided market maker, thus allowing traders to both sell and buy contracts at will. The traders must depart from the current price, and how far they can push the price in either direction depends on what level the price is at, how much money she has, and how much the operator has decided that one unit of money should affect the price at any given level.

Figure 5: Graph of Logarithmic Market Scoring Rule price function used for the 2009 Norwegian parliamentary election prediction market trials.



Source: own data

In an effort to compromise among the considerations of ensuring liquidity and minimizing software impediments in revealing the traders’ expectations of election outcomes, I decided to implement the logarithmic market scoring rule as the automated market maker in our software.

Although the market maker is the best option at hand, the logarithmic function may sometimes pose a problem for vote share predictions. It takes an increasing amount of monetary units to push the price down (or up) when the price is lower (or higher) than 50 per cent. For vote share markets, this is a particular drawback when the market contains contracts for parties with low support. We had one such contract, and that was the Liberal Party (Venstre) contract. Our solution to

this challenge was to contain this particular contract between 0 and 10 per cent rather than 0 and 100 per cent. This way the “neutral” position for the Liberal Party was 5 per cent instead of 50 per cent, thus allowing the contract to be traded more realistically. With this solution we bet that the Liberal Party would not exceed a vote share of 10 per cent, but as this has not occurred since 1965, it was a risk we were willing to take.

Another critical decision to make was how much impact we wanted the participants to have on the predictions. This is determined by the size of the “b” parameter in the logarithmic function, which sets the liquidity in the market (Pennock and Sami 2007). In a continuous double auction market, any trade needs both a trader that offers a price and another one that accepts the price, this way limiting the risk of “deviant” predictions generated by single traders. With the automated market maker, however, there is always an offer available. Hence, if one trader has too much power to move the prices, the prices have the potential to become very volatile. On the other hand, we did not want to excessively restrict the trader’s ability to move the predictions, as this could impede the traders’ possibilities for expressing their collective expectations at any given time. It was finally decided that one trader should be able to move the vote share prediction of one contract by one percentage point so long as the contract’s current level was at 50 per cent and that the trader spent all her monetary units.

The trial period

The article on Norwegian prediction markets explains how the participants were recruited, and shows that the majority of volunteers were faculty, students, and active party members of the Liberal Party and the Labour Party. The recruitment period started at the end of the 2009 spring semester and lasted up until the trials started, which was six weeks before election day. A letter was sent out prior to the trials, in which the participants were informed about the purpose of the trials and how they were to go about trading. When designing the software, a top

priority was to make the user interface as friendly as possible to new participants. Emphasis was put on facilitating the trading procedure so that even those who had no prior knowledge of market trading would intuitively know how to express their beliefs about the outcome. In order to achieve this, the main question we wanted them to think about was, “given the monetary units you have, how far do you want to move the prediction from its current level?” rather than, “how many shares do you want to buy/sell on this contract?” For all those who were interested in stocks and flows, information about this was of course also provided. To move the price, the traders simply had to slide the bar to the right, which indicated a buy, or to the left, which indicated a sell. Before they made the final decision, real-time updated information was provided about the eventual new prediction and what this move would cost the traders in monetary units. Based on this, the traders could contemplate the consequences of their actions one last time before going through with it. To further facilitate the use of the software, all the participants were given trial instructions over the phone prior to the opening.

When the trial was underway, caution was exercised in influencing the trading behaviour of the participants. No one should have felt obliged to make a trade if they thought the current predictions were correct. Instead, a weekly newsletter with information about the developments in the market for the past week was sent out. Traders who had not logged in to the site were also contacted, as they clearly were inactive and not just holding their positions. Despite our efforts, there were still some volunteers who did not actively participate in the trials. This was anticipated, but in hindsight, the design of the trials should have been less ambitious or should have involved more participants. I recruited participants vigorously, but was not able to increase the number within the scope of the project resources. The party members seemed particularly hard to motivate, possibly because they were very busy during the election campaign. All in all, however, the number of participants was within the accepted range suggested by

previous research, and did not fall below the critical mass needed to maintain the integrity of the trial.

The market predictions from the participants who were not active party members were displayed openly on the websites for anyone to see. The predictions from the active party members, however, were inaccessible to everyone other than the participants and the organizers. There was a fear that the party members would feel a need to inflate their expectations about their own party's achievements at the polls if outsiders could monitor their predictions. The decision to maintain the market predictions from the external markets (i.e. participants that were not active members of a party) as openly accessible to the public was a choice based on the desire to maintain a transparent environment surrounding the trials.

The rest of the trial period went smoothly, and all the data were stored automatically in the software. At this point, the data was ready for analysis.

To sum up, this section has discussed some of the features of the methods applied in the dissertation articles, as well as the data collection process. In the following, I conclude by summing up the empirical findings.

Conclusion

By comparing, testing, and applying methods of predicting elections, this dissertation makes several important empirical findings:

- The vote share of the Norwegian left bloc parties is positively dependent on national unemployment figures and negatively associated with incumbency.
- When compared to poll projections, prediction markets do a better job in accurately predicting the outcome of the 2009 Norwegian parliamentary election.
- Monetary incentives in prediction markets are likely to bolster trading activity in prediction markets.
- The effects of optimism bias/wishful thinking that comes from active party membership are not cancelled out by the prediction market mechanism.
- The ad campaign from the Swift Boat Veterans for Truth was an enlightening event in the 2004 US presidential election that released an anticipated vote potential for the presidential incumbent candidate, George W. Bush. The Lehman Brothers collapse in 2008, on the other hand, changed the vote potential in a negative direction for the incumbent party's candidate, John McCain.

As this dissertation has shown, there are many ways to form expectations about the outcomes of upcoming elections. While expectations might be based on polls, there are also complementary methods that take an entirely different approach to information gathering and processing, and these methods contribute to our ability to foresee election results and to identify voter trends. Economic vote forecasting models make *ex ante* predictions to test the impact of important political and economic determinants on the aggregate vote. Prediction markets

provide an arena for well-informed traders with rational incentives to accurately predict the election outcome, and their predictions tend to be the best educated guesses we have at hand. As the experiment laid out in this dissertation has shown, this was also true for the 2009 Norwegian parliamentary election. Moreover, the traders react differently to campaign events than do poll respondents, thus providing valuable insight into how to interpret the impact that these events have on the forthcoming election result. As of today, polling surveys of the voters are the dominant method of gathering information about the voters' political preferences. They probably will and should remain so in the future, as they use the method of representative sampling to show the current preferences of the voters. However, with the supplementary approaches from vote forecasting models and prediction markets, we are even better equipped to form expectations about future elections and to understand the causes of election outcomes than we are with polls alone.

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PART II: The journal articles

1:

Arnesen, Sveinung. "Out of work and out of office: The golden mix for left bloc support in Norway". Accepted for publication pending minor revisions in *The International Journal of Forecasting*.

2:

Arnesen, Sveinung. 2011. "Informasjon, motivasjon, prediksjon: Eit forsøk med prediksjonsmarknad før stortingsvalet 2009". *Tidsskrift for samfunnsforskning*. 2011; 52(1):99-121.

3:

Arnesen, Sveinung. 2011. "How prediction markets help us understand events` impact on the vote in US Presidential Elections". *The Journal of Prediction Markets*. 5 (3):42-63.

