

Potential of Idea Futures Markets in Educational Technology

David L. Passmore & Evin Dogan Cebeci
Workforce Education & Development
305D Keller Building
The Pennsylvania State University
University Park, PA 16802-1303 USA

Abstract—The concepts and methods used in commodity and financial futures markets are adapted to structure “idea” futures markets. Instead of trading on future prices for commodities or financial instruments, an idea futures market trades on the likelihood of realization of a specific, identifiable, operational proposition at some future point in time—an idea. Shares in an idea future are bought and sold using standard market methods. The price of a future reflects the aggregated information over all traders about the probability associated with the proposition. Prices rise or fall based upon changes in information perceived by market participants. Idea futures markets have strong applicability to strategic, tactical, and logistics decisions about the development, diffusion, and implementation of educational technology products.

I. INTRODUCTION

Delineating, obtaining, and providing information for management decisions are crucial to the success of the development, diffusion, and implementation of any educational technology product. Yet, such information for educational product decision-making often is pricey, complicated to obtain, and collected and disseminated in an *ad hoc* manner rather than continuously.

Decision-makers must forecast answers to many questions about educational technology product and resource markets under conditions of uncertainty and risk. For instance:

- Will customers buy and adopt an innovation in educational technology?
- Will developers deliver an educational technology product by an agreed deadline, and, if not, how far will the delivery slide beyond the original due date?
- How do external factors—political, social, or economic trends and events—affect the market for an educational technology product?

Obtaining answers to these types of questions about educational technology products frequently involve costly surveys, focus groups, opinions of high profile, identified experts, and aggregation and integration of a wide variety of information that affects markets for educational technology

products. Also, the methodologies applied to answer these questions require research expertise to manage and produce information that, in turn, demand technical analytical skill to consume and apply to decision-making. Moreover, such information frequently is so costly and complicated to obtain that it typically is collected once, not continuously, which may limit the quality and timeliness of decisions made.

In this paper we review emerging applications of commodity and financial futures market concepts and technologies to the analysis of propositions about the occurrence of an event by a subsequent point in time. Reference is made in the literature to these emerging applications as “idea futures,” “decision markets,” or “prediction markets” to indicate the structuring of markets to handle less tangible propositions about the future than commodities or financial instruments.

Although idea futures markets are most commonly used to aggregate information about the likelihood of future scientific, economic, political, and social developments and events, we believe that idea futures markets have applications to decision-making about educational technology products. In particular, we assert that idea futures markets can provide information for decision-making about managing the development, diffusion, and implementation of educational technology products in ways that are cost-conscious, relatively simple, and dynamic.

In the remainder of this paper we, first, outline general concepts and methods of commodity and financial futures markets to provide a basis for understanding the operation of idea futures markets. Next, we summarize the operation of some extant idea futures markets to reveal the nature and variety of current applications. Then, research and development designed to extend idea futures markets to decision-making are reviewed selectively. And, last, we delineate ways in which idea futures markets could inform decision-making about the management of educational product development, diffusion, and implementation.

II. COMMODITY AND FINANCIAL FUTURES MARKETS

A futures contract is an agreement to buy or sell an asset at a certain time in the future for a certain price [1]. In this way, the buyer and the seller reduce their risks and uncertainties surrounding future prices and commodity availability by establishing the current price for a commodity for delivery at a future date. Of course, any two parties can agree to a contract for a commodity (“Hey, deliver 100 bushels of corn to my roadside stand tomorrow.”). However, buyers and sellers often are distant from one another, require orderliness in a transaction, and flexibility as needs change. Standardization in futures contracts makes them fungible by specifying the grade of a commodity (e.g., No. 2 yellow corn), quantity (e.g., 5,000 bushels), and delivery date (e.g., 1 September). Only the price is left to be determined.

Futures markets are traceable to the Middle Ages when they were developed to meet the needs of farmers and merchants facing risks of price variation of grains due to conditions of oversupply or shortage brought on by weather, disaster, war, or politics. Futures contracts provided a means for reducing risks due to the uncertain future of grain prices. Formal commodities exchanges came into existence to act as intermediaries between buyers and sellers. The Chicago Board of Trade and the Chicago Mercantile Exchange were established in the mid-19th century in the United States to make markets for buyers and sellers of commodities. In 1972, the International Monetary Market was established as a division of the Chicago Mercantile Exchange for futures trading of foreign currency. Futures markets are one of the most successful financial innovations for commodity assets and for such financial assets as currencies, bonds, or stock portfolios.

The equilibrium price settled for the commodity at the execution of a futures contract summarizes current intelligence of supply and demand conditions anticipated at the time of future delivery. In this way, following the so-called Hayek hypothesis [2, 3] in economics, the price discovery process in a futures market is an aggregation of market information and knowledge that is held by the entire pool of buyers and sellers who bid or ask for futures contract prices. Futures markets for contracts on, for instance, metals, energy, farm products, T-bonds, interest rates and various financial instruments are well-established in the investment community.

III. IDEA FUTURES MARKETS

A recent innovation involves transferring the framework, tools, and methods for handling commodity and financial futures to use in futures markets for ideas. Instead of trading on commodities or financial markets, an ideas futures market trades on the likelihood of the realization of an idea. Idea markets trade on propositions about whether

an event will occur and when. The “price” of the idea proposed (1) reflects the aggregated believe that the proposition will be realized, (2) is dynamic, in the sense that it is updated continuously based on market activity, and (3) is responsive to the perceptions of “idea” traders about factors—especially external political, social, or economic factors—that are thought to affect the realization of the proposition.

A. The Foresight Exchange

The *Foresight Exchange* (<http://www.ideosphere.com>) is an example of an idea market. The *Exchange* bills itself as “the place to test your ability to predict the outcome of future events. It is also the place to check the current odds of upcoming events and make your own bets (<http://www.ideosphere.com/fx/docs/FXdocs.cgi#Welcome>).” One proposition in the *Foresight Exchange*, with the ticker name **Bush04** (<http://www.ideosphere.com/fx-bin/Claim?claim=Bush04>), asserts the following claim:

G. W. Bush, the president of the United States at the time this claim started trading, will still be president on 2005-02-01 (after the inauguration after the election is usually scheduled).

The following criteria are provided for judging the realization of the claim:

This claim will be TRUE even if elections are postponed or G. W. Bush remains in power by staging a coup. If there are events which make it confusing who the US president is, as of 2005-02-01, this claim is true if G. W. Bush is leading a sovereign government in at least part of the territory of the United States of America (as of 2001-01-01) that has recognition of at least one of the UN Security Council permanent members (Britain, France, China and Russia) other than the United States.

Fig. 1 is the “price plot” for this claim through mid-January 2004, which displays the dynamics of changing beliefs that this claim will be realized.

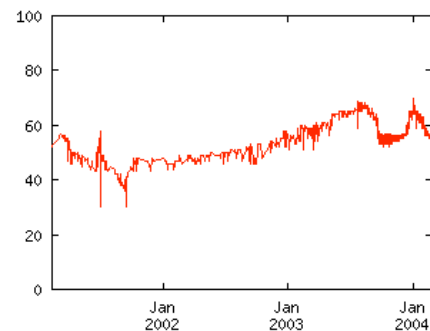


Fig. 1. Price plot from *Foresight Exchange* with dynamic changes in beliefs in continuing presidency of George W. Bush.

Among the most prominent idea futures markets currently operating in addition to the *Foresight Exchange* (which features a variety of scientific, political, and cultural events) are the *Iowa Electronic Markets* (electoral events; see <http://www.biz.uiowa.edu/iem/>), the *Hollywood Stock Exchange* (box office returns, opening weekend performance, Oscar awards; see <http://www.hsx.com/>), and *TradeSports* (mainly sporting events, but also includes current legal, political, financial, and weather events; see <http://www.tradesports.com>). The most controversial idea futures market, by far, is the *Policy Analysis Market* (<http://www.americanactionmarket.org/policyanalysismarket.org/>).

B. Iowa Electronic Markets

The *Iowa Electronic Markets* are small-scale, on-line, real-money futures markets in which contract payoffs depend on economic and political events such as elections, companies' earnings per share, and stock price returns [4, 5]. These markets are operated by faculty at the University of Iowa Tippie College of Business as part of their research and teaching mission. Participants buy and sell by opening accounts for a minimum of \$5 and a maximum of \$500. The markets operate 24 hours per day using a continuous double-auction trading mechanism.

The *Iowa Electronic Markets* are unique in the sense that they allow use of participants real money, as opposed to fictional currency as in the *Foresight Exchange*. Participants use their own funds to buy and sell contracts. Traders, therefore, have the opportunity to profit from their trades, but must also bear the risk of losing money. Because of the use of real money for trading, the *Iowa Electronic Markets* are under the regulatory purview of the Commodity Futures Trading Commission (CFTC). The CFTC has issued a "no-action" letter to the *Iowa Electronic Markets*, stating that as long as the *Iowa Electronic Markets* conform to certain guidelines, the CFTC will take no action against the *Markets*.

The use of participants' real money is important because, as the old adage goes, no one spends your money better than you do. Due to the real consequences of loss or gain, participants in the *Iowa Electronic Markets* are stimulated to seek information about the markets in which they participate. It is this stimulation that sharpens the quality of the market price realized for any proposition.

A salient point often noted in discussions of the *Iowa Electronic Markets* is the relative accuracy of the forecasts of political election results provided compared with traditional political polls. Although the comparison with polls might not be completely fair [6], the *Iowa Electronic Markets* have shown no obvious biases and, on average, considerable accuracy for large U.S. election markets [7]. Presidential election markets performed better than lower profile congressional, state, and local election markets. Markets with more volume near election time performed

better than those with less volume. And, markets with fewer contracts (i.e., fewer candidates or parties), predicted election outcomes better than those with more contracts. These attributes are desirable when the relative high costs of political polls versus the relatively low costs of idea futures markets are considered.

C. Hollywood Stock Exchange

The *Hollywood Stock Exchange* is an idea futures market structured along the same lines as the *Iowa Electronic Markets*. The *Exchange* allows for trading on securities corresponding to movies (this is called "MovieStocks"), including those in production and in theaters, using fake money called "Hollywood Dollars." Each movie security is liquidated four weeks after the release of the movie for \$1 per \$1 million in box office gross.

Similar to "MovieStocks," a "StarBond" represents actors and directors that are traded on the *Exchange*. The price of a "StarBond" reflects overall star power as determined by *Exchange* traders, as well as how much money celebrities films make at the box office as determined by their trailing average gross (TAG). Beginning with their second film, "StarBond" prices are adjusted to match the TAG when celebrities credited "MovieStocks" cash out. If a celebrity should happen to meet the end of a career (death, retirement, etc.), the "StarBond" is cashed out at the TAG.

Although there is virtually no research on the *Hollywood Stock Exchange*, it represents a very popular entertainment mechanism. The structure of the *Exchange* is quite sophisticated, with reserve and investment banks, leader boards, trading clubs, tickers, insider trading, funds, options, warrants, and even its own "Hollywood Securities and Exchange Commission." Based upon the volume of trades and other activities, the *Exchange* demonstrates how active an ideas future market can be when it captures public interest.

TradeSports

To classify it plainly, *TradeSports* is a gambling forum. It is run on-line from Ireland, so it evades anti-gambling laws in effect in many countries such as the United States. Shown in Fig. 2 are some of the trades accessible recently

Today's Highlights						
	Symbol	Bid	Ask	Last	Vol	Chge
①	OSAMA.CAPTURE.JUN04	12.6	16.0	17.0	16.2k	0
②	DEM04.VP.EDWARDS	24.7	24.9	26.0	14.1k	0
③	NHL.REDWINGS	23.0	26.0	25.0	1938	-5.0
④	PRESIDENT.GWBUSH2004	58.0	58.7	58.0	275.8k	-0.7
⑤	NBA.LAKERS	33.0	35.0	34.1	24.2k	-0.9
⑥	MLB.YANKEES	21.5	24.0	22.0	3436	0

Fig. 2. Trades available on *TradeSports*.

on one trading day. What differentiates *TradeSports* from many other on-line gambling outlets is the diverse betting topics that it covers and the use of market mechanisms to operate its betting system. As seen in Fig. 2, among the prominent trades available are traditional sports bets (Will the Los Angeles Lakers win the National Basketball League championship?), contracts related to terrorism (Will Osama Bin Laden be captured), and the likelihood of political outcomes (Will Senator J. Edwards become the Democrats vice-presidential candidate for the 2004 U.S. presidential election). Quite a diverse betting portfolio.

There are no handicappers setting the odds for *TradeSports* bets. Rather, the price is driven entirely by market transactions and self-organizes under market principles. Also, *TradeSports* demonstrates that, given sufficient motivation, many people can learn the intricacies of idea futures trading.

D. Policy Analysis Market

One of the most controversial idea futures markets was the quickly-aborted *Policy Analysis Market* that was sponsored by the U.S. Department of Defense. The underlying idea for the *Policy Analysis Market* was to build and test markets that would allow defense and intelligence analysts to speculate about such strategic and geopolitical issues as the probabilities of specific kinds of failure within the national infrastructure. Its goal was to develop market-based techniques for avoiding surprise and predicting future events.

The now-archived *Policy Analysis Market* web site provided an example of a complex derivative assembled from two idea futures contracts tied to the now-historic case of pending hostilities between the United States and Iraq: (1) whether the Jordanian monarchy would be overthrown during hostilities between the United States and Iraq and (2) the ability of the Iraqi regime to persist for more than one month of hostilities (see http://www.americanactionmarket.org/policyanalysismarket.org/pam_example.htm). A *Policy Analysis Market* trader who feels comfortable with both issues might choose to trade a contract on a joint outcome, a type of market derivative. *Policy Analysis Market* held the promise of applications of a variety of similarly rich market analysis tools to anti-terrorism analysis.

The *Policy Analysis Market* was cancelled by the U.S. Department of Defense during late 2003 due to the controversial political nature of the speculative propositions about that it would consider. The *Policy Analysis Market*, also known as *FutureMAP*, was criticized by U.S. politicians as more of a “market for death,” “a federal betting parlor on atrocities,” and “an incentive actually commit acts of terrorism,” rather than a decision tool. One analyst opined that “The *FutureMAP* debacle has provided a setback, maybe a permanent one, to anyone who might have hoped to use information markets in administrative

decisionmaking” [8].

III. SELECTED RESEARCH APPLICABLE TO IDEA FUTURES MARKETS AS DECISION TOOLS

In spite of the setback to implementation caused by the *Policy Analysis Market* cancellation, research and development burgeons on the construction, use, and evaluation of idea futures markets. A major focus of this research and development is on the use of idea futures markets for aggregating information about future events and trends for decision-making. After all, much government policy relies on predictions of the future. Government agencies assess whether promulgated regulations will have desired consequences. Economic policy anticipates future economic conditions and problems. In the private sector, enterprises judge the structure and quality of future markets and plan strategy to hedge against or ride with social, political, and economic trends in their external environments.

A. Authority

Although governments and business routinely use, either implicitly or explicitly, information forecasting the future for decision-making, administrative and corporate law in the United States is mum about the status of forecasts as decision tools. For instance, case law in the United States is not clear about whether forecasts are “fact-finding” or “policy decisions,” each of which are subject to different criteria of probative certainty [8]. Much research and discussion is necessary to establish the formal, legal status of idea futures markets as decision tools.

B. Information Aggregation Mechanisms

A lemma of rational expectations theory in the field of economics is that current prices reflect the sum of all knowledge in an economic system. Prices are thought to efficiently aggregate information about the underlying states of the economy. Earlier, the classic work of Hayek [2] suggested that processes in naturally occurring, free markets make important contributions to information transmission in economies. However, more recently, experimental economists have treated this lemma that markets are information aggregation mechanisms more as a hypothesis—“Hayek’s hypothesis”—requiring empirical testing [3]. Laboratory experiments reveal that that information aggregation is possible in simple markets [e.g., 9].

Idea futures markets, therefore, are capable of aggregating information efficiently, at least in laboratory situations with some fidelity to functioning markets. However, idea futures markets also are subject to problems such as information traps [10, 11], illiquidity [12], market manipulation [13, 14], and inability to settle on an equilibrium price [15, 16]. These problems are exacerbated

when the groups involved are small and have thin experience with the information being aggregated in the market [17]. Clearly, analysis of the functioning of idea futures markets as information aggregation mechanisms is an important and fruitful line of subsequent research.

C. *Small group decision-making*

Experience accumulated with idea futures markets, especially the *Iowa Electronic Markets*, indicates that simply structured markets with large numbers of participants perform information aggregation tasks well. Many decisions of interest, however, involve small groups of stakeholders, a situation that challenges the limits of usefulness of idea futures markets.

One study with Siemens Germany [18, 19] constructed two project management markets for a software development. One market assessed the claim, “Can the project be finished in the planned time horizon?” The other claim forecasted a delay by asking participants to buy “Early” or “Late” finishing coupons. Approximately 60 traders joined these markets, most of whom were male with little experience in stock markets. Market prices seemed to be sensitive to new information presented (e.g., prices changed when information became available about possible supplier delays). In fact, participants seemed particularly adept at anticipating new information about the software development project long before it was available through official sources and at integrating rumors and intuition into their market activity.

A number of studies (see, e.g., [17]) have applied Bayesian estimators to integrate prior information about risk aversion into estimates of equilibrium prices in idea futures markets with small numbers of participants. This process operates in two stages. First, an idea futures market is run to extract risk attitudes from market participants, along with the participants ability to predict a known outcome. Constructed from this information is a nonlinear aggregation function that allows for collective predictions of uncertain events. Second, these same participants engage in a market for a uncertain event, with rewards provided for the accuracy of market forecasts. Individual market transactions are integrated using the nonlinear function and are used to predict the outcome of the uncertain event. This use of prior information outperforms both the market for the uncertain event as well as the most accurate market participants.

IV. POTENTIAL APPLICATIONS IN DECISION-MAKING FOR EDUCATIONAL TECHNOLOGY INNOVATIONS AND PRODUCTS

We believe that idea futures markets provide interesting and useful solutions to a number of planning, evaluation, strategic, and project management decisions facing managers of educational technology innovations and products.

A. *Planning*

Managers are interested in the likelihood that an educational technology product will be purchased or adopted. Who better to ask than the people who will sell or distribute the product? Good salespeople have direct contact with customers, and they are familiar with customer needs, culture, sophistication, and preferred patterns of operation. An idea futures market could be established along the lines of whether a new or anticipated product might yield a certain level of revenue by a particular date.

A joint research project between Caltech and Hewlett-Packard Laboratories [20] provided a field test of use idea futures markets for sales forecasting. A number of markets were established involving 20-30 participants who forecasted sales revenues for various products. Six of eight forecasts using idea futures markets outperformed official Hewlett-Packard sales forecasts. This field test was a powerful demonstration of the usefulness of idea futures market methods.

B. *Expected Impact*

The gold standard for determining the efficacy of any education product is the conduct of a true experiment in which subjects are assigned randomly to treatment and control conditions and outcomes are observed. However, rarely can conditions of random assignment be met in most practical, working settings. In addition, some organizations scarcely have the patience to conduct pilot tests of innovations, even under non-experimental conditions.

Often organizations turn to expert opinion about the anticipated efficacy of a product. Idea futures markets can provide an alternative by aggregating opinions about the expected impact of a new product or innovation from a wide variety of sources (customers, experts, workers). Certainly, this approach is no substitute for field tests of products (who wants a cancer drug deemed efficacious and safe by an idea futures market without direct evidence with human subjects?), but it might prove a useful adjunct information gathering strategy.

C. *Project Management*

Failure to meet deadlines in educational technology product development creates problems throughout the supply chain and production environment. Also, failure to meet announced deadlines reduces credibility with customers. Idea futures markets could help forecast whether complex design and development projects are likely to meet deadlines, and, if not, how long deadlines must be extended. Middle managers and planners already focus on these problems, but idea futures markets can aggregate information from all parties and partners in the production cycle. An important problem with implementing idea futures markets to monitor project management is with the moral hazard generated when morale and motivation suffer due to forecasted failure to meet deadlines [21].

D. Environmental Scanning

Is the market for an educational technology product or innovation affected by political, social, or economic factors external to the organization? This is the type of question typically asked during an organization's strategic planning activity. For instance, an organization might believe that the level of federal educational expenditures is an indicator of the general business climate for its products and services. An idea futures market could track and forecast these expenditures in a formal way.

A National Bureau of Economic Research study [22] found, for instance, that a *TradeSports* market for "Saddam Securities" moved closely with the spot price of oil. The "Saddam Securities" asset paid off if "Saddam Hussein is not President/Leader of Iraq by [Date]," with the [Date] selected over various horizons for key contract dates of December 2002, March 2003, and June 2003.

So, using the specter of Hussein's continuation as Iraq's leader as a proxy for the likelihood of war and disruption in the Middle East, analysts were able to create a derivative security that indicated that war could raise oil prices by \$10 per barrel, lower the value of U. S. equities by 15%, and bolster gold and energy markets. Managers of educational technology product development, diffusion, and implementation could develop similar derivatives by tracking product sales conditional on regulatory, political, social, or economic factors external to the organization.

E. Identification of Expertise

Who makes the best expert judgments of strategic, tactical, and logistic matters regarding development, diffusion, and implementation of educational technology products and innovations? In short, who is an expert? Often, these questions are answered by referring to positional leadership ("He's the department head, after all.") or elite position ("She holds the Chair in Educational Technology at Muckity-Muck U."). However, expertise is not general over all matters. Intuition, situational intelligence, knowledge of niche matters, and quality of experience and the learning that has occurred as a result are distributed widely. Idea futures markets capture this distributed knowledge very well. Because trading statistics are known, the trading behavior and effectiveness of individuals can be assessed. In this way, experts could be identified based on accuracy of forecasts, not by rank or station.

REFERENCES

- [1] J. C. Hull, *Fundamentals of Futures and Options Markets*, 4th ed, Englewood Cliffs, New Jersey: Prentice Hall, 2000.
- [2] F. A. Hayek, "The use of knowledge in society," *American Economic Review*, vol. 35, no. 4, pp. 519-530, 1945.
- [3] C. R. Plott, "Markets as Information Gathering Tools," *Southern Economic Journal*, vol. 67, no. 1, pp. 1-15, 2000.
- [4] J. Berg, and T. A. Rietz, "Prediction Markets as Decision Support Systems." *Information Systems Frontiers*, vol. 5, no. 1, pp. 79-93, 2003.
- [5] R. Forsythe, F. Nelson, G. R. Neuman, and J. Wright, "Anatomy of an Experimental Political Stock Market," *American Economic Review*, vol. 82, no. 5, pp. 1142-1161, 1992.
- [6] J. Berg, F. Nelson, and T. Reitz, "Accuracy and Forecast Standard Error of Prediction Markets," Unpublished, Henry B. Tippie College of Business Administration, University of Iowa, July 2003.
- [7] J. Berg, R. Forsythe, F. Nelson, and T. Rietz, "Results from a dozen years of election futures markets research," Unpublished, November, 2000, Retrieved October 30, 2003 from http://www.biz.uiowa.edu/iem/archive/BFNR_2000.pdf.
- [8] M. Abramovicz, "Information Markets, Administrative Decisionmaking, and Predictive Cost-Benefit Analysis," Unpublished, AEI-Brookings Joint Center for Regulatory Studies Related Publication 03-18, August, 2003.
- [9] C. Plott and S. Sunder, "Rational Expectations and the Aggregation of Diverse Information in Laboratory Security Markets," *Economica*, vol. 56, pp. 1085-1118, 1988.
- [10] C. Camerer and K. Weigelt, "Information Mirages in Experimental Asset Markets," *Journal of Business*, vol. 64, pp. 463-493, 1991.
- [11] M. Nöth, C. Camerer, C. Plott, and M. Weber, "Information Traps in Experimental Assets Markets," In press, *Review of Financial Studies*.
- [12] S. Sunder, "Markets for Information: Experimental Evidence," *Economica*, vol. 60, pp. 667-695, 1992.
- [13] R. Forsythe and R. Lundholm, "Information Aggregation in an Experimental Market," *Economica*, vol. 58, pp. 309-347, 1990.
- [14] M. Nöth and M. Weber, "Information Aggregation with Random Ordering: Cascades and Overconfidence." Unpublished, University of Mannheim, 1988.
- [15] L. Anderson and C. Holt, "Information Cascades in the Laboratory," *American Economic Review*, vol. 87, pp. 847-862, 1997.
- [16] D. Sharfstein and J. Stein, "Herd Behavior and Investment," *American Economic Review*, vol. 80, pp. 465-479, 1990.
- [17] K. Chen, L. R. Fine, and B. Huberman, "Forecasting Uncertain Events with Small Groups," Paper presented at the October 2001, ACM Conference on e-Commerce October, 2001.
- [18] G. Ortner, "Forecasting Markets—An Industrial Application, Part I," Unpublished paper, Vienna, Austria, Technical University of Vienna, Dept. of Economics and Industrial Organizations, July, 1997.
- [19] G. Ortner, "Forecasting Markets – An industrial Application, Part II," Unpublished paper, Vienna, Austria, Technical University of Vienna, Dept. of Economics and Industrial Organizations, March, 1998.
- [20] C. Plott and K. Chen, "Information Aggregation Mechanisms: Concept, Design, and Implementation for a Sales Forecasting Problem," Social Science Working Paper 1131, Pasadena, California, California Institute of Technology, 2002.
- [21] T. Hogg and B. Huberman, "Avoiding Moral Hazards in Organizational Forecasting," Palo Alto, California, Hewlett-Packard Labs, June 13, 2002.
- [22] A. Leigh, J. Wolfers, and E. Zitzewitz, "What Do Financial Markets Think of the War in Iraq," Working Paper No. 9587, Cambridge, Massachusetts, National Bureau of Economic Research, March, 2003.