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Special Issue:
Corporate Applications of Prediction Markets

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INTRODUCTION TO SPECIAL ISSUE ON CORPORATE APPLICATIONS OF PREDICTION MARKETS

Koleman Strumpf[*]

1. INTRODUCTION

Most academic journals are destined to be read by a few specialists and then quickly archived to dusty bookshelves. This special issue has a very different aim. It is primarily intended to be a gentle introduction for business practitioners interested in corporate applications of prediction markets.[1] While it is easy to find laudatory reports on these markets in the popular press, such stories are typically based on only one or two case studies. This special issue seeks to bridge this gap, by collecting the experiences of several pioneers in corporate prediction markets.

The authors in this issue are especially well-suited guides. They all have intimate first hand knowledge of these markets, whether organizers at their companies or as academics who have studied the actual workings of these markets. The articles are based on their presentations at the "Conference on Corporate Applications of Prediction/Information Markets," held at the Kansas City's Kauffman Foundation on 1 November 2007.[2]

Though the papers here highlight the potential for prediction markets to assist in firm decision-making, this is not a Pollyannaish assessment. Rather the special issue seeks to provide a sober assessment of both the benefits and

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[1]Prediction markets utilize the knowledge of a pool of individuals to help forecast questions of importance to companies, such as whether a sales target will be reached or whether a project will be completed in a timely manner. A more recent development is the use of such markets to generate and evaluate new ideas, such as new products or cost saving procedures

[2]The sponsors of the conference were the University of Kansas School of Business, the Center for Applied Economics, and the Kauffman Foundation. I served as the conference organizer. The archive for the conference, which includes the complete schedule as well as notes on each talk, is available at: http://people.ku.edu/~cigar/PMConf_2007/PredictionMarketsConference.html

possible costs of these markets. Prediction markets are not a magic elixir and will have a limited impact when they are applied to the wrong sort of questions or embedded in a dysfunctional environment. At the same time, under the right conditions these markets can be an extremely valuable aid for company decision-makers. The papers here glean such general lessons from actual markets.

In the next section I lay out why companies are a particularly interesting test-bed for prediction markets. While firms are well positioned to utilize the information which prediction markets generate, they also face special challenges such as opposition of employees which currently control information flow within the company. The third section provides an executive summary of each article, along with a recap of the accompanying commentary pieces. As my summary points out, the papers not only provide basic information but also raise a number of thought-provoking questions which are currently the subject of active research. The future development of corporate markets will require the teamwork of both practitioners and academics to solve these problems. Finally, the last section concludes

2. WHY COMPANIES?

The first known corporate applications of prediction markets occurred about a decade ago. Since then, over a hundred companies have run internal markets. These firms span the size spectrum, including some of the largest in the world to those with only a handful of employees, and they cover a broad range of sectors, including those whose products are abstract ideas to others which manufacture the most low-tech products. Why have such a broad range of firms become interested in prediction markets? The answer lies in a common problem facing firms.

Prediction markets have been employed to help combat a leading factor in bad decision-making, the isolation of executives from the views and insights of the company's workforce. Such seclusion is no accident but instead reflects one of the reasons companies exist in the first place, namely to avoid information overload for already busy executives. To reach this goal firms developed a hierarchy structure, and assigned to middle management the task of deciding how much and what information was transmitted from employees to higher-level decision-makers. But this system has its costs, as potentially useful information may be filtered out if it reflects poorly on those who control the information flow. At the same time, lower-level employees have little incentive to make reports which conflict with their managers, who may

later punish them for their candor. The net result is that executives may only receive one-sided information, and flawed and unproductive decisions can result.

This is where prediction markets come in. Suppose the CEO must decide whether to continue funding a research project, but he is concerned that he has been receiving overly optimistic reports on its prospects from managers who will benefit from the project continuing. A market on the project's prospects would allow front-line employees to convey more realistic information, and they could do so without fear of reprisal so long as trading is anonymous. Prediction markets are also likely to function better than other approaches currently in use. For example, group meetings are less likely to have frank discussions while suggestion boxes do not scale well (prediction markets tend to perform better when there are more participants). And while most workers dread the thought of meetings, markets are often considered a fun and typically do not require much incentives to generate active employee involvement.

This motivation aside, there are also particular reasons to think that companies are well positioned to utilize the information generated from prediction markets:

- company divisions often serve as standalone silos, and markets can be a means of integrating the pockets information contained in each
- executives may be interested not just in market aggregates, such as prices, but also the trades of particular groups of employees. For example, one could examine whether members of certain divisions are less prone to making biased forecasts.
- companies need real-time information about the many uncertain events surrounding their decision-makers
- firms can internalize the informational benefits of the market. A company can profit from the information generated from prices, since the market can be kept private and outside of the purview of competitors.

The last point is particularly important. Since the benefits of the markets largely accrue to the company, we should expect many prediction market innovations to first arise in a corporate setting. For example, companies have been the first to experiment with using these markets to generate and evaluate ideas. One of the surprising results of these markets is that the ideas come not just from research staff but also (to borrow a phrase from Jim Lavoie, a contributor to this volume) the "quiet geniuses" whose suggestions are typically ignored.

At the same time corporate applications of prediction markets provide several unique challenges:

- they face special legal requirements such as avoiding insider trading laws
- they must overcome investor reluctance to a project with upfront costs and possibly delayed benefits
- there are impacts on employees, both detrimental (markets may distract staff away from their main responsibilities) and beneficial (there is often a gain in morale, as workers feel empowered because their market-mediated suggestions are impacting corporate decisions)
- employees may sabotage a project in order to profit from a market on its prospects. There is an unfortunate asymmetry here, since it is far easier for an employee to engineer an unfavorable outcome for the firm than it is to create a favorable one.
- the markets may overwhelm executives with too much information
- market organizers must allay concerns of middle management and others whose current role in the company is threatened by the market

The last two points highlight the delicate balance needed with internal markets. While the markets can provide executives with timely and unfiltered information, too much of this will be difficult for already busy executives to process and effectively utilize. This suggests that the markets should focus on targeted topics of particular interest in the executive suite. Similarly if the markets are too much of threat to those who currently regulate information flows in the corporate hierarchy, then these managers will lobby hard to eliminate them or prevent them from gaining traction in the first place. Markets which focus on the creation of ideas, rather than forecasts, are likely to generate less of this kind of opposition, and thus may be easier to implement.

Such general principles aside, it is important to stress that prediction markets may only be appropriate for certain kinds of questions. For example, prediction markets have had difficulty in forecasting outcomes in which the fundamental information is quarantined from market participants (for example, in forecasting the decision of a secretive government committee).

As this discussion points out, prediction markets are likely to be a better fit for some companies (and for some questions) than others. To evaluate whether to use markets, it is important to weigh the costs and benefits listed above. The tradeoff may be favorable only in for certain kinds of firms, such as those where the corporate culture already embraces experiments.

3. PREVIEW OF PAPERS IN THIS ISSUE

The papers in this special issue span a wide range of topics related to corporate markets. The subject matter includes tips on how to establish markets, on how to tweak a market to obtain certain goals, what pitfalls to avoid, as well as highlights of some of the exciting state-of-the art applications occurring in companies today. Accompanying each paper is a commentary which helps put the work in context. I briefly note some of the key highlights of each paper, but I highly recommend reading each in their entirety.

Jim Lavoie, a co-founder of Rite-Solutions, writes about his personal experience with internal markets (this paper is based on the keynote address at the 2007 conference). Jim lays out the reasons why he has made such markets an integral part of his company, and he provides a host of practical tips on how to get markets up and running. Jim also touches on some of the successes he has had with these markets, such as boosting employee morale and improving innovation. He also describes the novel use of these markets to both elicit and evaluate new ideas, an application which is now known as an Idea Market (the next paper in this volume discusses Idea Markets at GE). This is a wonderful paper for those curious about whether an internal market would be a good match for their company, and given its cutting edge application to idea markets it a fount of ideas for researchers and experienced practitioner alike. Jim has also set up a website, http://artofinnovation.net/, which allows readers to sample some of his Rite-Solutions markets.

Art Hall, who heads the Center for Applied Economics at University of Kansas, comments on Lavoie's piece. Art points out some of the potential pitfalls in the application of markets within companies. He shows how Rite-Solutions has been able to incorporate the markets into their corporate culture, which has allowed them to liberate pent-up creative instincts. At the same time, he notes the managerial challenges which must be met to get markets to operate successfully.

The second paper in the volume is by Brian Spears, Christina LaComb, John Interrante, Janet Barnett, and Deniz Senturk-Dogonaksoy, and it discusses GE's experience with Idea Markets in its Energy division (these authors organized and operated GE's markets). The authors show how GE has used these markets to generate and rank new ideas. A wealth of information is provided on topics ranging from participation rates to trader satisfaction with the markets to a quantitative appraisal of how well the markets elicit and rate ideas. There is also a very detailed description of the mechanics of the markets, such as the incentives given to traders and to creators of new ideas, which will be of particular interest to those looking for tips on how to

structure a market at their own company. The authors also chart out some important avenues for future work, such as how to deal with the unusual trading behavior of idea creators. The numerical analysis in this paper serves as nice complement to the qualitative discussion in the earlier Rite-Solutions paper. Given that Idea Markets are one of the most exciting applications of corporate markets and GE and Rite-Solutions are the unquestioned leaders in this area, these papers are essential reads.

Marco Ottaviani offers commentary on the GE paper. Marco notes that the creation and evaluation of ideas are fundamentally thorny issues both within companies and more generally. He also highlights two leading challenges to the use of Idea Markets. Since the market expires before any of the ideas in the market are implemented, it is difficult to validate which idea is in fact best (in contrast the truth is observed in standard prediction markets, e.g. we know whether printer sales exceeded their goals for this quarter). A second issue involves the potential manipulation of the prices by an idea creator, who can potentially benefit if the market identifies his idea as the best. Marco offers some tentative solutions to these issues, and notes that working on a fuller solution is an important topic for both academics and practitioners.

The third paper in the volume is from Henry Berg and Todd Proebsting, who have jointly run a variety of prediction markets at Microsoft. Their paper focuses on some practical issues associated with the implementation of an automated market maker (AMM). An AMM is a mechanism which overcomes the illiquidity problem of many prediction markets: what happens if a market participant shows up and no one else stands ready to trade with him? The AMM stands ready to accept all trades on either side of a contract, and so allows the participant to immediately execute his trades. Such AMMs are now commonly employed in most corporate prediction markets as well as many public ones. Henry and Todd provide formulae which they have used in their implementation of an AMM at Microsoft. They also provide a range of practical tips for how these formulae can be tailored to other applications, as well as provide suggestions for other important aspects of market design which encourage both participation and appropriate trading behavior.

Robin Hanson, whose research laid out the foundations for most implementations of AMM's in prediction markets, is the commenter on the Microsoft paper. Robin provides an intuitive introduction to AMM's, which will be of particular use to those who have not encountered them before. He also discusses various practical issues with the AMM, and how it is flexible enough to be adjusted to suit a market administrator's particular goals.

In the fourth paper Adam Siegel, a co-founder of Inkling Markets, writes about his experience as a vendor and organizer of prediction markets (Inkling has helped a blue-chip list of corporate clients, such as Johnson & Johnson,

Chevron, and CNN, set-up and run markets. Inkling also runs several public markets which may be found at http://home.inklingmarkets.com). This article serves as an excellent how-to guide for companies just starting to experiment with prediction markets. Adam first lays out the case for why companies should consider using markets as a means for improved decision-making on topics such as project planning and resource allocation. He also provides a list of practical tips for market administrators, such as the need to promote interest among potential traders/employees and to provide a constant stream of new markets. A set of challenges which the new market is likely to confront is also provided. Adam concludes with a practical check-list which will allow companies to decide whether prediction markets are a good fit for them. A real bonus for practitioners is the insights and lessons provided by two of Inkling's clients, Cisco and a global consumer products company.

Paul Rhode's commentary on the Inkling paper points out the close connection of the benefits and challenges from corporate applications of prediction markets. One potential benefit from these markets is the facilitation of information flows within the company hierarchy, mitigating the censoring and potential bias from middle management. At the same time, Paul points out one of the reasons we have companies is to economize on transaction costs and information overload among executives. Middle management's winnowing of information can be a crucial time-saver for busy executives. And from a less altruistic perspective, these middle managers will strongly oppose markets if they view them as a challenge to their information hegemony. Paul points out that a successful corporate market will only be possible if these and other issues are adequately addressed.

Tom Bell authors the last paper in this issue. Tom's paper is a bit different from the others in that he is writing not about the workings of a corporate market, but rather he is addressing the rather murky legal environment which surrounds them (Tom is one of the leading law scholars studying firm markets). The legal issues are far more than an academic curiosity, as some firms have decided to steer clear of prediction markets to avoid exposure to litigation or government regulation. As Tom shows, understanding the legal status of a company's market is quite complicated. While issues related to gambling laws can be mitigated through the use of play money, any market potentially violates securities laws through the creation of new classes of insiders. Solutions to the latter questions are more subtle, and some (such as the public disclosure of market outcomes) may reduce or even eliminate the benefit of the information which the market collects. Tom goes on to suggest better solutions to these and other problems. He also discusses the wide range of regulatory changes currently being considered, any of which will have important implications for the legality of corporate markets. Clearly the legal

issues surrounding corporate markets are in need of further study, and it will be leading scholars such as Tom who will help provide that scholarship. This article is a must read for anyone interested in using such markets.

Robert Litan's comment on this paper also notes the rather uncertain legal environment surrounding corporate markets. While many companies have braved these issues and started their own markets, the potential legal repercussions may have dissuaded others. Robert points out that regulators seem to have placed a premium on avoiding speculation rather than encouraging innovative new mechanisms such as prediction markets. He further notes that the overlapping jurisdiction of several regulators such as the SEC and CFTC itself creates legal anxiety and further discourages the spread of markets. Even if corporate markets do not receive a clear stamp of legality, Robert points out several ways in which current regulations could be improved.

4. CONCLUSION

My hope is that this volume will serve as a guide for future applications of prediction markets. At the same time, the papers here raise several thought provoking challenges which practitioners and scholars will grapple with for some time to come. It will be exciting to see the solutions and also to see whether prediction markets deliver on their potential in a corporate setting.

Readers interested in even more details on the topics raised here should consult the archive of the original Kansas City conference which includes presentations from the authors here as well as from other companies involved with prediction markets (a link is provided Section 1).

Finally, if you are interested in starting your own corporate market and have questions, please feel free to get in touch with me directly at cigar@ku.edu. If I am not able to directly answer your question, I will try and connect you with others in the field that can.

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THE INNOVATION ENGINE AT RITE-SOLUTIONS: LESSONS FROM THE CEO

Jim Lavoie [*]

BACKGROUND

I spent over 30 years in a highly structured, hierarchical organization where good ideas could only flow top-down and where the firm's intellectual capital was more defined by the level of organizational "box" that a person occupied than by the actual insight that person possessed. In January 2000, as a "second career", I set out to build a company that would be liberated from such restrictions of thought and, instead, would capitalize on the intellectual bandwidth of the entire organization to "Innovate Every Day". Such a company would be based upon two of my most fundamental beliefs: "No one is as smart as everyone", that is to say that good ideas are not bounded by organizational structure, but can come from anyone, in any place, at any time; and second, that the Hierarchical Pyramid as an organizational business structure is an enigma in the 21st century knowledge economy. An enigma more suited to controlling information flow than fostering innovation.

My challenge in building such a company was two-fold: to develop a mechanism that could "operationalize" innovation by tapping the collective genius in my organization in a non-intimidating, fun way to generate these good ideas continuously; and, second, to institute a new organizational model with enough control to operate as a responsible, profitable business, but with sufficient flexibility to leverage and disseminate brilliant, innovative ideas across the organization – that's all!!

II THIS PAPER'S INTENTION

This task, though daunting, has been greatly aided by the "knowledge workforce" that is emerging and the Web technology that is connecting this

[*] CEO Rite-Solutions

workforce in a manner never before experienced. My job has been to capitalize on these events in building a company designed for this future state, which I believe will be a significant strategic discriminator as time goes on.

The two pillars of this new breed company are a unique organizational design that operates as team-oriented nodes on a network as opposed to the hierarchical pyramid and our Innovation Engine. The latter is designed to provoke and align thought among all of our people while the former is necessary to foster collaboration that helps to nurture and mature good ideas as opposed to the traditional filtering and restricting of innovative thought that occurs in most organizations today.

In this article, I will address, in some detail, our Innovation Engine as a principle means of Tapping an Organization's Collective Genius. I will try to briefly answer:

What is it? Why use it? Who benefits from it? And How?

III THE INNOVATION ENGINE IS NOT A PREDICTION MARKET

First, let me start by clarifying what the IE *is* and just as important, what it *is not.*

My vision was to create an organization where innovation happened everyday - with or without me and would alleviate me of the burden of always having or selecting the right ideas. For the first two years of operation, I struggled with the mechanism that would provoke our people to think in order to capitalize on the intellectual bandwidth of the entire workforce; to align the "collective genius" of their ideas in a business sense, and then to assess the value of those ideas in a constructive, non-threatening manner. I started with several more traditional means – innovation summits (as if innovation is a timed event), white boards throughout the facility for people to scribble down their innovative ideas (nothing is more depressing than empty white boards), and an Innovation Room that would help foster the creative process (more conducive to naps than great ideas). Finally, I hit upon the idea of a game, mirrored after the Stock Market, where ideas could be launched in a socially friendly, non-intimidating electronic forum and the peer group would assess the potential value of these various ideas by purchasing stock with their Opinion Money (every employee, including me, gets $10,000), and, more importantly, by volunteering their time to mature and build upon the idea. The "price" of a stock, then, is driven by an algorithm that takes into account the peer group's opinion, willingness to contribute, and desire to help build the product idea. The game approach capitalized on several factors of the new

workforce: they enjoy competitive games: many of them are introverts who shun the spotlight but still want to contribute; they have amazing bandwidth to contribute on a 24 hr. basis to things that excite them; they will openly provide their best efforts in a cooperative environment that is supportive rather than judgmental. The game proved to be very successful. To date we have generated well over 50 innovative product, service, and process ideas. Over 15 of these have been successfully launched and currently account for approximately 20% of our total revenue. As important, we have filed for 12 patents for innovations that we believe have great value to the company's future. (All IE investors acknowledge that all IP that stems from collective genius is the property of the company.)

Many have confused our IE with Predictive Market Tools. The fundamental difference between the two is that the IE seeks to generate new ideas which have the potential to *create* a new future state while Predictive market Tools are aimed at *evaluating* the most likely future state. In short, the Innovation Engine (IE) is focused on creating the future rather than spotting trends faster than co-workers. While Predictive Tool set up win/lose scenarios, the IE employs a socially friendly network as a safe electronic forum that recognizes that good ideas can come from anybody, anywhere, at anytime in the company. It recognizes the great contribution that the quiet geniuses can make to a company if they have a chance to present their ideas in a comfortable way, and where they can solicit the intellectual bandwidth of others to help an idea mature. The IE gives ideas a chance to grow before business metrics clutter the idea germination phase. Used in this way, the Innovation Engine serves as an ideal input device to predictive tools for topics of interest to the organization and may be best employed in concert with predictive tools that leverage employee intellectual creativity with the truth vetting features and reality checks of a Prediction Market.

I hope that this clarifies what IE is and what differentiates this tool from Predictive Market tools. In the following sections, I will discuss, in greater detail, my motivation for developing the IE and how it works within Rite Solutions. Finally, I will explain what the tool does for me, as CEO, and what I believe it has the capacity to do for all CEOs.

IV MOTIVATION FOR THE INNOVATION ENGINE

To fully understand my motivation in developing the IE, it is necessary for me to explain my view of the future workforce which I believe will be driven by two factors: Web 2.0 technology and the traits of the Y Generation

At its core, Web 2.0 has to do with the next generation of interaction with the World Wide Web as a much more interactive, collaborative network engagement that connects businesses and people in a more natural manner.

When I speak of Web 2.0, however, I'm speaking of this movement in the broader sense of its impact on culture and organizational design. For the Y Generation entering the workforce, the old norms associated with Command & Control organizational structure embodied in the hierarchical "pyramid" design, are no longer relevant. In the world of Web 2.0, information will no longer be controlled and then "doled out" as a source of power. Employees will expect, and demand, total transparency, and if they cannot get information from their "boss", they will seek answers elsewhere. Relevancy, then, to this generation is no longer based upon the old paradigm of hierarchical power but rather upon the notion that "good ideas and useful information can come from anyone at any time". This fact that divorces information flow from corporate position means that the future organizational design will necessarily mirror its most enabling function – a network. In our company, we have embraced this fact and implemented an organizational design of individual, functional teams, acting as nodes on a network, "publishing" information that is freely passed along to anyone "subscribing" for that information. Such a structure is more in-line with the socially friendly environment of community, collaboration, and innovation promised in a Web 2.0 world.

As important as new organizational structures will be to *enabling* the full power of Web 2.0, there is still the need to generate these "good ideas" that *fuel* a Web 2.0 environment. This is the function of the IE. Just as important to generating innovative ideas, the IE becomes a way to engage the Y Generation in striving for the betterment of the organization; to ensure that they feel relevant in a very tangible way to the success of the business, and to tap their amazing intellectual bandwidth far beyond "job tasks" to be performed. The IE, then, becomes a mechanism to take the employee relationship beyond the transactional level (I pay you, you do a job) to an emotional level where they are entrusted with the future direction of the company, asked for their opinions, listened to, and rewarded for successful ideas. The benefits of such an approach are astounding. Not only are ideas freely generated, vetted, supported, and nurtured, but enduring loyalty is fostered which directly impacts reduced attrition, development of a healthy collaborative culture, and self-forming communities of interest around ideas and concepts.

Couple this with the fact that the Web 2.0 world and the intellectual bandwidth of the Y Generation will greatly enhance the opportunity for collaboration and creativity; it becomes a competitive imperative that

companies find a way to harness this power. This is at the heart of my corporate mission to Innovate Every Day. Those who fall short of this mark will be left behind in tomorrow's marketplace.

V OBJECTIVES AND BENEFITS OF THE INNOVATION ENGINE

The following provides greater detail on some of the underlying objectives of the IE including some personal insights that drove much of the creation and instantiation of this tool at Rite-Solutions. I provide this granularity in the hope that these underlying objectives will resonate with other leaders and leadership teams. I suggest to other leaders that they at least consider these items to allow the entire intellectual bandwidth of their organization to emerge more often than annually, or semi-annually. Who knows; maybe even daily?

#1 – **You (management) have to get introverts involved or you're missing the large majority of your Intellectual Bandwidth.**

Be honest…offsites are for extroverts. Extroverts are experts in passion and theatre and play an important role in idea shepherding, but most of your genius is in your introverts. The only nice thing about an offsite event for an introvert is that it ends! We made the innovation offsite a 24/7 on-line game that our introverts see as a safe-haven for sharing. We developed a game called The Intellectual Capital Investment Market as a way to collect ideas into common groupings and allow everyone to get involved by using their Intellectual Capital.

Some ideas are right in our "sweet spot" as a company. These are low risk ideas that we call Blue Chip Stocks (low risk/probably a good (safe) investment). There are other ideas that save money which in-turn affects our bottom line performance. Guaranteed cost reduction ideas are called Savings Bonds (money in the bank). There are also high risk/high reward ideas that are a little scarier, but you need to have a few to penetrate new areas. In our game, these are called Futures. And sometimes we just want to survey what our people think about some of the things we're contemplating or ideas that are germinating, so we have penny stocks where employees can easily give us their 2 cents.

#2 – **You (management) have to make it part of your daily 24/7 fabric. (Don't expect "just in time" innovation)**

People can play anytime they feel like a little mental gymnastics outside the normal project challenges. Typically, this happens outside both the office and the normal work hours. It occurs in the white space (where all innovation comes from), and often the office is not the best place for white space. Secure access via any web browser and you're playing. It all starts by developing your own personal intellectual capital investment portfolio in the company.

#3 – **You (management) have to provoke thought. (If provoked to think, thinking takes place; if told to do, only doing gets done)**

ASK! – By asking knowledge workers their impression of our initiatives for the future, we provoke them to think about our collective future and glean the combined impression of our folks on which ideas have the best promise for the company if those ideas are pursued. Knowledge workers tend to pass on ideas where they have little understanding or interest and move on to ideas where they have some insight.

#4 – **You (management) have to align everyone's Intellectual Bandwidth. (To your future)**

Guide their involvement in your future - By watching activity and intellectual capital alignment in the engine, you'll see where their intellectual bandwidth is being applied to move ideas forward, and now you (management) can get in the game "behind" the bandwidth.

For us, these are called "Budge-It Items" (small steps to move an idea forward). It's amazing to watch as investment clubs self-form around different initiatives. These self-forming teams are a lot like after school activities (clubs). Clubs center around a common activity for their own good. You don't have to assign anyone to anything, they simply belong to an initiative they select by virtue of interest, curiosity, or because it matters to them.

#5 – **You (management) have to recognize behavior and reward results. (It's free money)**

Give lots of reward and recognition away. Positive recognition is usually very inexpensive and takes many forms in the knowledge economy. Introverts like recognition as much as extroverts, only differently. The IE has a ticker tape, a leader board for short and long term IE contributions, patents with

contributing employees as inventors, and just being acknowledged as a part of an organization's future is all it takes to cause an employee to grow deeper roots within the organization. For us: ideas that lead to savings or profit lead to a pay off for the investment team of 25% of the savings for a two year period, or 25% of the profit for a two year period. Sometimes it's a little money, sometimes it's more, but the point is that for the organization, it's free money that they realized only through the intellectual bandwidth of invested employees. Also, spouses see the pay-off of working on the company's future. It's like a part time job at your full time job and the rewards and recognition are clear.

#6 – **You (management) should make your entire workforce (including retirees) relevant. (Knowledge Tethering)**

Foster relevance. Most people want to contribute their intellectual capital to improve their organization but many organizations make it too hard for them to help. This is as true for our Generation "Ys" as it is for our "Knowledge retirees". Knowledge retirees want to remain relevant on a "not to interfere with my next life basis" – Being and staying relevant is the most important intellectual goal of a retiring knowledge worker. I know; I was one. It was no fun feeling like my contributions to something I cared about for so long were no longer necessary. It felt deeply necessary for me! With the Innovation Engine, I can retire this time and stay active in a community I know and care a lot about. Why would any company want to lose intellectual bandwidth?

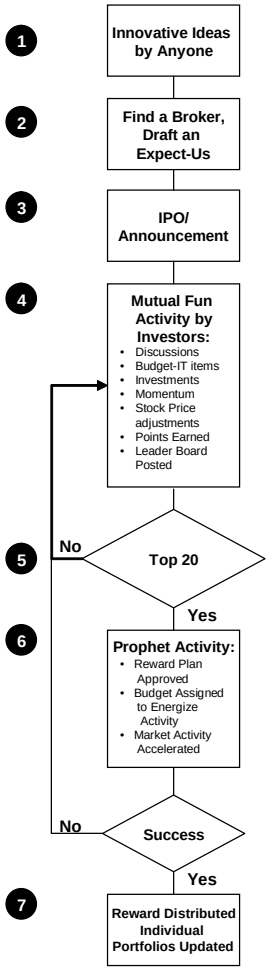
#7 – **You (management) can relieve yourself of the burden of being right while remaining relevant as their leader. (Breath easier)**

If you're helping to run a company and its innovating everyday, life is good.

VI THE IDEATION PROCESS

The flowchart that follows examines the process associated with getting an idea prepared, into, and out of the Innovation Engine. It is included to provide some clarity as to a typical sequence of events.

Innovation Engine Process Diagram



1. **IDEA**. Any employee in a knowledge organization is likely to have the next brilliant idea. It may come from two people discussing a problem, but it will almost certainly take the combined talents of several individuals to transform the idea into a successful idea on the stock market. If you, or you and a friend discover a possible brilliant idea, the way to begin to get Corporate and Community support is to fill out a Draft "Expect-Us" form within the Stock Market.

2. **If you need assistance**, under "Help" in the Stock Market is a category called "Brokers". These are people with experience in developing these documents and who volunteer to help new inventors. They will help you complete a Draft Expect-Us form and prepare a compelling entry into the market.

3. **IPO/Announcement**. Your Broker will IPO your idea into the Stock Market and announce to all employees using the market's Ticker Tape, that a possible brilliant ideas has emerged. This is when the fun begins.

4. **Mutual Fun Activity**. Smart employees with varying talents from around the company may make the new idea a part of their portfolio. If they decide to "buy into" your idea as part of their portfolio, it means that they believe your idea has merit and deserves further discussion and investigation. There is a discussion feature within every stock on the market. It is here that people begin to massage your idea. As investment activity increases, the "Price" for that idea rises. Increased "Investment Activity" and "News" will likely provoke more "Mutual Fun" activity, which will likely provoke more "Harvested Brilliance", "Budge-IT Items", "Intellectual Capitol Investments" and so on. As people take stock in your idea (buy-in) as part of mutual fun, their combined interest (compound interest) in your idea is ranked by combining all portfolio allocations. If your idea reaches the "Top 20" for momentum it automatically attracts additional corporate support. (i.e., time and money)

5. **Top 20**, for all "Top 20" ideas, the "Adventure Capitalists" (Senior Leaders) assign a "Prophet". The "Prophet" develops a necessary budget and a "Reward Plan". The budget is intended to fuel activity. The "Reward Plan" is prepared to document the "Reward" that will be shared between the inventor and the "intellectual capital investors".

6. **Prophet Selected**. The "Prophet" works to provoke talented people to apply their competencies toward the realization of an inventor's idea. This includes taking part in discussions, identifying small steps of progress to move the idea forward. These small steps are called "Budget-IT items". The "Prophet" also posts progress on the "Ticker Tape" for all to see and to keep the investment team motivated.

7. **Success**. A "Success Beacon" has been described as part of the Expect-Us preparation. When an idea reaches that point, it can be taken off the market. When a stock is successful and is "cashed out" of the market, the "Mutual Fun" portfolios that contain that stock are updated to include new "Unallocated Mutual Fun Currency". Also, this triggers the Rewards for the inventor and the intellectual capital Investors.

   NOT Successful. A stock can be removed from the market for several reasons; such as:
   1. We give up (not a good technology, no user market, won't work, things changed)
   2. Impressions and Interest are very low
   3. It is combined with a similar stock.

VII A FEW LESSONS LEARNED

When some companies read about the Innovation Engine, they immediately licensed and launched the product within organizations much larger than Rite-Solutions (175 employees). The result was not good. Here are a few lessons learned from those hasty launches.

A. Match.com - At Rite-Solutions, everyone knows everyone. In very large geographically dispersed organizations, people didn't know enough about the other people to know who could help them with an idea. This prompted an enrollment feature to be added to the Innovation Engine as well as a "WHO?" search feature. Enrollment simply gathers an individual's interests, hobbies, curiosities, passions, expertise, etc. into a central repository for use by the WHO? function. When a person has an idea, they use the WHO? function to identify a likely community interested in their idea by selecting from a list of attributes that match to the repository of interests, hobbies, competencies, etc. This narrows the field quickly within a large organization to probable "kindred spirits".
B. Human Bias - At first we had the stock price controlled by a person who watched the market and raised stock prices based on activity. This introduced a bias into the process that was removed by an algorithm that raises and lowers stock prices based on intellectual activity by the player pool.
C. Gaming the Game - In the first revision of the product, players could view other player's portfolios and the statistical graphics of the cumulative impressions. This led to new employees simply following the crowd instead of giving their honest assessment. Now, players have no short-cut to portfolio plagiarism.
D. Watch Longer – If you inject too much management too early, it hinders the creativity and can choke bandwidth
E. The IE is not magic – poor cultures are not good candidates for this type of social product

VIII A BIT MORE ABOUT PLAYER TRACKING

We were fortunate. Rite-Solutions is involved in Player Tracking/Loyalty programs for the entertainment industry. Our software applications keep a close eye on player behavior and tracks trends in the data. In this way companies create customer profiles and can provide more targeted rewards for their customers. We embedded this functionality into our product for much

the same reasons, but also as a way to create the slightest bit of competition into the game. Additional byproducts of including this software into the product were also gleaned. They are:

- We are able to automatically generate a leader board for our Headlines Page – the new leader board illustrates recent leaders (e.g. quarterly) and the Legends Leader Board displays top contributors since instantiation.
- We can automatically calculate stock prices based on activity – taking the human out of the loop and allocating different points to individuals for different levels of contribution.
- We can quantify "innovation" for stocks and individuals – by awarding points and tracking all play, an individual can contribute a percentage of 100% of the innovation points.
- We can graph momentum over time – as momentum builds among employees, we look for ways to accelerate the group toward a success milestone.
- We can recognize individuals on the ticker tape for all to see – recognition is a big deal in a social network.
- We can increase people's portfolio amounts based on their intellectual capital expenditures – this gives them more influence and a bigger plate at the buffet.

IX HOW TO LEARN MORE FOR YOURSELF

The art of innovation can be sampled by readers at:
http://artofinnovation.net/sm.nsf

At this site, I have included several employee ideas in each intellectual capital index (Savings Bonds, Blue Chip, Futures, and Penny Stock). You may want to just poke around for a while and play the game a bit to get familiar with some of the functionality and vocabulary. Any thoughts you have to improve our intellectual bandwidth are welcome. (jlavoie@rite-solutions.com)

X CONCLUSION:

Too early to tell; but, it's more fun and rewarding than the command and control method I used for 30 years. I have relieved myself of being solely responsible, as the CEO, for recognizing and sheparding the next Big Idea for

the company. I'm exploiting people's intellectual capital to make my life easier and provide more opportunities for relevance to all my knowledge workers (introverts and extroverts). We have recorded double digit growth in top and bottom line every year since using the Innovation Engine and greatly increased our Intellectual Property (IP) portfolio in the process. Note to CEOs using prediction markets: an accurate prediction is nice; the right patent; priceless.

This article talks about my personal views on innovation management and intellectual bandwidth, but only skims the surface in describing the power of a continuous Innovation Engine fueled by the combined power of an empowered organization.

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THE CHALLENGE OF INCENTIVE ALIGNMENT IN THE APPLICATION OF INFORMATION MARKETS WITHIN AN ORGANIZATION

Art Hall[*]

Prediction markets have captured the imagination of business thinkers—much like chaos theory captured it a decade ago. The urge is to apply prediction markets to a host of business challenges just like the urge was to apply insights of chaos theory to business challenges. However, the intelligent application of prediction markets within organizations may be no easier than the intelligent application of chaos theory to business strategy.

I have chosen the comparison to chaos theory for two reasons. First, the excitement about prediction markets seems to me to have the same type of buzz that chaos theory carried in the late 1990s. Second, and more to the point, Jim Lavoie's reference to the business potential of Web 2.0 tools arguably offers a platform for capturing some of the more realistic goals of those who once urged businesses to operate "on the edge of chaos"—as captured by the title of this popular-audience book: *Surfing the Edge of Chaos: The Laws of Nature and the New Laws of Business.*[1]

It is easy to become excited about the success Lavoie and his colleagues at Rite-Solutions have had with prediction markets while also under-appreciating how remarkable an accomplishment it represents from a management perspective. I say that as someone with limited—but relevant—experience in trying to facilitate and coordinate creative thinking and action across business units of a large conglomerate and the agencies of a state government.

The force of bureaucratic inertia combined with the interpersonal dynamics of large organizations creates a formidable gauntlet for innovation. Lavoie understands these phenomena well from his considerable career experience. That is why he and his partner, Joe Marino, tried from day-one to

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[1] Richard T. Pascale, Linda Gioja, Mark Milleman, *Surfing the Edge of Chaos: The Laws of Nature and the New Laws of Business* (New York: Crown Business, 2000).

prevent them from forming in their new company. This effort is documented in a Stanford University case study on Rite-Solutions.[2]

DISTINGUISHING AMONG TYPES OF INCENTIVES

The prediction market developed by Rite-Solutions, called Mutual Fun, is, as Lavoie suggests, more akin to a Web 2.0 social networking tool than a conventional prediction market. It succeeds at merging an "idea market" with a "prediction market," though both are stylized to fit with the organizational dynamics of Rite-Solutions.

A paper co-authored by GE's Christina LaComb, one of the conference participants, provides a useful discussion about the difference between idea markets and prediction markets (two different types of information markets). It also provides a useful discussion about the importance of incentives: "As with any business incentive system, a considerable challenge exists in choosing incentives that motivate the right behavior. . . With information markets, incentives must serve a dual role: to motivate participation and to motivate participants to provide truth-revealing opinions. Incentives that satisfy both criteria can be difficult to define."[3]

The notion of "motivation to provide truth-revealing opinions" has different aspects within an organizational context. The easier aspect, which economists can handle reasonably well, relates to prediction market design and the structure of payoffs. The more difficult aspect relates to an organization's (often unspoken) rules and norms for sharing information and making decisions, commonly, but awkwardly, referred to as an organization's "culture." In my experience, the influence of such cultural elements on incentives will overwhelm the incentives of even the best-designed information market, especially in a more free-flowing idea market context.

In this regard, the work environment at Rite-Solutions has everything to do with the firm's successful implementation of information markets. The same environment is also a precondition for capturing the innovation potential described by those business thinkers encouraging firms to operate "on the edge of chaos" or embracing "complexity," a more general term denoting the dynamics of a complex adaptive system.

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[2] Hayagreeva Rao and David Hoyt, "Rite-Solutions: Mavericks Unleashing the Quiet Genius of Employees," Case HR-27, Stanford University Graduate School of Business, September 11, 2006.

[3] Christina Ann LaComb, Janet Arlie Barnett, and Qimei Pan, "The Imagination Market," *Information System Frontiers*, Vol. 9, Nos. 2-3, July 2007, p. 254.

The importance of this point related to operating culture seems lost on some segments of the scholarly community but second nature to other segments. Fundamentally, the question relates to how well a particular organization can capitalize on exogenous or endogenous nonlinear phenomena (disruptive change, in the popular-audience business literature).

A special issue of *Organization Science* noted: "Organizational scholars seldom come to grips with nonlinear phenomena. Instead, we tend to model phenomena as if they were linear in order to make them tractable, and we tend to model aggregate behavior as if it is produced by individual entities which all exhibit average behavior. . . It is difficult to know how to draw a conceptual model and how to report the results of empirical inquiries into complex organizational phenomena."[4] However, outside the academy, at the Santa Fe Center for Emergent Strategies, Howard Sherman and Ron Schultz argued that: "Differentiating between the mechanistic-linear qualities of trend analysis and organic-nonlinear [business opportunities] has nothing to do with numbers and everything to do with learning to evaluate nonlinear feedback."[5]

Sherman and Schultz employ the phrase "adjacent possibilities" to describe the array of unrealized opportunities a business organization faces. "The key," according to the authors, "is to develop the capacity within an organization to step outside the industry, view from that vantage point the way business is conducted, and imagine other possibilities. We call this innovation."[6]

The notion of adjacent possibilities—and the organizational ability to recognize and capture them—fits comfortably with the intellectual traditions of entrepreneurship articulated by Joseph Schumpeter and the resource-based theory of the firm articulated by Edith Penrose. Schumpeter emphasized that the essence of economic competition relates to "new combinations" for the use of existing resources.[7] Penrose argued that the growth of a business organization is dynamically constrained, in part, by the limited capabilities of

[4] Philip Anderson, et. al, "Introduction to the Special Issue: Applications of Complexity Theory to Organization Science," *Organization Science*, Vol. 10 (3), March 1999: 233.

[5] Howard Sherman and Ron Schultz, *Open Boundaries: Creating Business Innovation through Complexity* (Reading, MA: Perseus Books, 1998), p. 132.

[6] Sherman and Schultz, pp. 22-23.

[7] Joseph Schumpeter, *The Theory of Economic Development: An Inquiry into Profits, Capital, Credit, Interest, and the Business Cycle* (Cambridge: Harvard University Press, 1959), p. 74.

the organization's human resources.[8] (Jim Lavoie might refer to such capabilities as the firm's "intellectual bandwidth.")

John Kay, the noted British scholar of business strategy and a proponent of the resource-based theory of the firm, argues that the business organizations that are adept at recognizing and capturing adjacent possibilities have somehow managed "to create consummate, rather than perfunctory, cooperation."[9] Kay argues that business organizations with this (rare) attribute have built a "network of relational contracts within or around a firm" that allow the firm to "create organizational knowledge and routines, to respond flexibly to changing circumstances, and to achieve an easy and open exchange of information."[10]

Returning to the topic at hand: Why is deep incentive alignment—at the cultural level of an organization—perhaps a necessary condition for reaping the power of information markets as a business tool? Kay notes that "There is no room for team spirit in a world of spot or classical contracts. . . One can benefit from a cooperative ethic, or the knowledge and expertise of others, only in the context of reiteration and reciprocation."[11] Truth-revealing opinions require—especially in the context of idea markets—this richer environment of relational contracts. A well-designed pay-off structure may be inadequate. And even in the context of a straightforward prediction market, authentic participation may rely on a trust that decision-makers within the organization will heed the information generated by the market.

All of the elements of the above discussion are intuitive for Lavoie (and Marino). He built a company around these ideas. As the Stanford case study notes: "Rite-Solutions . . . developed a tool, Mutual Fun, to help bring out and develop their employees' ideas. The tool, however, was more than just a way of developing innovations. It was a tangible embodiment of a company culture of trust and collaboration."[12] The firm's free-flowing set of relational contracts helps create the consummate cooperation needed for a Web 2.0 tool to channel the firm's "intellectual bandwidth" toward the discovery and implementation of adjacent possibilities.

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[8] Edith Penrose, *The Theory of the Growth of the Firm*, 3rd Edition (New York: Oxford University Press, 1995), Chapters 3 and 4. Also see, John Cantwell, "Innovation, Profits and Growth: Penrose and Schumpeter," in Christos Pitelis, ed., *The Growth of the Firm: The Legacy of Edith Penrose* (Oxford: Oxford University Press, 2002), pp. 215-248.

[9] John Kay, *Why Firms Succeed: Choosing Markets and Challenging Competitors to Add Value* (New York: Oxford University Press, 1995), p. 68.

[10] *Ibid*., p. 63

[11] *Ibid*., p. 71.

[12] Rao and Hoyt, p. 14.

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EXAMINING TRADER BEHAVIOR IN IDEA MARKETS: AN IMPLEMENTATION OF GE'S IMAGINATION MARKETS

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ABSTRACT

We present the outcome of an idea market run for one of GE Energy's sub-businesses in July and August of 2006. GE Energy used this market to elicit and rank-order technology and product ideas from across the sub-business. In this experiment, we examine the behavior of traders that have submitted the ideas on the market and their influence on the market's outcome. An idea's submitter is clearly motivated to have his idea valued highly by the market, both by the funding given to the top idea as well as smaller prizes given to the top three ideas. In general, founders tended to buy their suggested ideas at prices above the volume-weighted-average-price (VWAP) in significant volumes. We discuss the implications and mitigation strategies. A survey of market participants yielded mixed results regarding the market's effectiveness at ranking ideas but very positive results regarding the quality of ideas proposed.

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KEYWORDS

Idea market, prediction market, idea generation, brainstorming, group support system.

1. INTRODUCTION

General Electric has been experimenting with idea markets for the purposes of collaborative brainstorming and idea ranking. Our specific implementation of idea markets is called Imagination Markets.[1]

Idea markets, also called preference markets, are a special form of prediction markets specifically designed to aggregate preferences; participants buy and sell securities based on their preferences. Unlike prediction markets, the underlying objective value of the securities is not known at the close of the market. Instead, the securities' value is based on the opinions of the participants. Chan, et al. has done important work on idea markets. Chan demonstrates that idea markets used to aggregate opinions are consistent with opinions collected via web surveys. He asserts that markets may improve upon traditional survey methods by encouraging greater honesty from the participants, providing participants with valuable feedback from other participants, and offering participants "the joy of competitive play."[3]

GE's Imagination Markets help us answer tough business questions such as "What new technology ideas should we be investing in?" and "What new products should we be developing?" Market participants can submit their own ideas for entry into the market, and they can buy and sell shares of any idea in the market based on how well they believe the idea will contribute to the market's (and the GE business's) objectives. Example objectives include contributing the most to growth or developing new revenue streams. At the end of the market, shares are valued using the volume weighted average price over the last 5 days of trading.

GE's interest in idea markets stem from our belief that innovative new product and service ideas can come from anywhere within an organization. Since innovation is a key component of General Electric, the generation of new ideas is one of the first steps in the planning of research projects and allocation of research funding. Similar to most companies, GE utilizes a variety of methods to generate and down-select new ideas. While the process varies from business to business, new ideas are typically generated by traditional means, including suggestion boxes and brainstorming sessions. These traditional means of encouraging new ideas within businesses have

considerable limitations. Suggestion boxes often go unused because contributors receive little or no feedback about their idea or visibility into others' ideas. Brainstorming sessions are often infeasible for soliciting ideas from large, globally distributed teams with potentially thousands of contributors. A small team, usually management, through their expert evaluation of the ideas' viability, typically performs the ranking and down-selection of ideas. By extending a traditional information market to allow participants to contribute ideas throughout the course of the market, we have created a tool that leverages the participants' expertise to identify ideas, as well as to effectively rank them. This tool was developed to augment the existing methods for idea generation and ranking, providing another data point in the overall idea generation and ranking process.

A discussion of our initial Imagination Market, justification for design choices, and early results are presented in LaComb, Barnett, and Pan (2007). This paper presents an idea market executed in 2006 for a sub-business of GE's Energy business and was the fourth of ten Imagination Markets we have run thus far. In this market, we changed several design aspects from our original Imagination Market. Specifically, we removed short selling since earlier participants had found it to be confusing. Instead, in this market, we allocated initial shares of every idea to every participant at the time the idea entered the market. We also changed our original design to value the portfolio during the course of the market based on the volume-weighted average price of the last five days of trading, instead of the last trading price. Further information regarding these design changes are outlined in the section below titled "Design of the Market and Securities".

Our objectives for the Imagination Market technology are to: 1) generate more ideas than are obtained through other traditional mechanisms, 2) make everyone within the organization a part of the idea generation process, and 3) identify the best idea. The ideas selected through the Imagination Market process may be directly funded or the outcome of the Imagination Market may be another data point in the ranking and down-selection process.

In earlier markets, we noticed the tendency of the individual who submitted an idea to be over-exuberant in the trading of their own idea. We analyze the behavior of the idea submitter in the trading of his own idea and discuss impact and mitigation strategies.

DESIGN OF THE MARKET AND SECURITIES

There are many choices for market design. Duration, participants, incentives, anonymity, and financial structure are just a few of the many

Design	Reason
Participant community	All salaried employees in the US and Europe in one of GE Energy's sub-business were invited to participate. Those invited did not participate in earlier markets.
Initial seed securities	The market was seeded with eight ideas generated before the market opened so there would be securities to trade at the start of the market.
Addition of new ideas (securities)	We accepted new ideas for the first two weeks of the three-week market. A cross-functional team from the business reviewed ideas and chose which ones to include in the market based on how well they fit the idea criteria presented to traders prior to market start. Ideas were also selected to represent a wide breadth of business areas in the market. Members of the review committee did not otherwise participate in the market.
Initial allocation of shares for each security	Each participant was given 15 shares of each security at no cost. Participants also received $3000 in play money to invest. At the end of each week, registered participants received an additional $1000 play money with which to trade. This was unlike the design of our first Imagination market, where participants were given only cash and were allowed to take short positions on securities. We removed the short selling option because many traders were confused by the short selling implementation. We then chose to provide everyone with initial shares, which they could sell to express their opinion that the value of the security was lower than the current price.
Pricing of shares	In the creation of limit orders, traders were allowed to set any price they wanted from 1 to 99 dollars per share. Ideas' "current" prices were simply their last traded price. But unlike the design of our first Imagination Market, we used the volume-weighted average price from the last five trading days when calculating an ideas' relative worth in the portfolio during the course of the market. Use of the last trading price as the method of valuing securities throughout the course of the market had two limitations: 1) it resulted in a tendency of traders to trade a small number of shares in order to see a short-term improvement in their portfolio value; 2) valuing based on the last trading price did not accurately reflect the final payout, which was based on the volume weighted average price.
Final payout to participants (and determination of the best idea)	The best idea was the security with the highest volume-weighted average price (VWAP) during the 5 business days prior to market close.
Market duration: 2 weeks, 5 days	We did not publicize a specific market close date to mitigate the risk of manipulation and tournament behavior as the close date approached.

Design	Reason
Anonymity	Whether suggesting a new idea or trading, all participants were only known to each other through their trader ids when interacting through the Imagination Market application. This allowed traders to express their true opinion about ideas without fear of retribution from other participants. We did not forbid traders from disclosing their identity outside of the market.
Discussion forums available for sharing information	We wanted participants to share opinions about the securities in an online format so we provided a discussion forum for each security.
Incentive for best idea: research funding	The reward for the best idea was $50,000 of research funding to pursue the idea. While the research funding represents a significant dollar amount, unlike the other incentives, this is money that is not directly provided to the employee. Instead it is allocated as internal time and resources that can be spent on the idea's development. An Apple iPod[4] was also awarded for the top idea.[1] Second and third place ideas received $100 and $50 gift cards, respectively.
Portfolio value-based incentives	The top trader (based on portfolio value) received an Apple iPod. The second place trader received a $100 gift card. The third received a $50 gift card. Although performance-based rewards have been proven to encourage tournament behavior, we felt that these incentives were necessary to encourage participation.[5]
Lottery incentive	Two $50 gift cards were awarded by random drawing (lottery). Lottery entries were created for each trade so the more a participant traded, the better chances they would have. The inclusion of this lottery incentive may mitigate the risk of tournament behavior. However, in future markets we may wish to include a lottery aspect to the performance based incentives by allocating a number of lottery tickets to the trader or idea in proportion to the performance of the trader/idea. However, since all traders face the same incentives on this market (even if they are in a tournament which encourages risk-seeking trading) our comparison of founder/non-founder results will still be insightful.

Table 1: Market Design

market attributes to consider. A thorough discussion and justification of our design choices is presented in LaComb, Barnett, and Pan (2007).

Tabel 1 describes some of our Imagination Market design decisions along with brief explanations of why the design choice was employed. In cases where specific design choices have changed since our first implementation, the reason for the change is provided.

Participants were given a set of criteria against which to evaluate the market ideas. We asked participants to set the price at which they were willing to buy or sell shares (minimum 1 dollar per share, maximum 99 dollars per share) based on how closely the idea fit the criteria. This allowed participants to not only evaluate ideas in a similar manner to each other, but to use criteria that management would ordinarily use to evaluate ideas. The criteria were:

- Ideas our customers will value, and
- Ideas that will produce the best return on investment, and
- Ideas that should be included for funding next year.

RESULTS

a. Participation

The sub-business was self selected based on their own knowledge of the Imagination Market program from GE's Global Research Organization. All salaried employees within the GE Energy sub-business were invited to participate. The sub-business is relatively small in size compared to the overall organization, which made coordination of the market somewhat easier. On the other hand, the sub-business is large enough and responsible for a fairly large breadth of product lines in the Energy industry to provide a relatively diverse base of participants. Of the 1,236 employees invited to participate, 186 (15%) registered for the market and 110 (9%) made trades. The trader population was reasonably diverse and represented all functional groups within the business, roughly in proportion with the functional and geographic distribution of the business as a whole. Traders were located in multiple locations across North America and Europe.

Forty of the traders served in Engineering roles and accounted for 25% of the total trade volume. The balance of the trading population served in roles such as project management, finance, marketing, sales, legal and human resources. Nineteen of the traders were in management positions and accounted for 6.5% of total trade volume. Total daily participation rates are shown in Figure 1.

Eight ideas were seeded in the market in order to get trading started. During the first two weeks of the market, we invited participants to suggest new ideas to be added as securities. Fifty-four new ideas were submitted; each idea was considered for entry into the market by a cross-functional

review team. If the review team approved the idea, it was added to the market and trading could begin immediately.

Thirty-two new ideas were approved and placed into the market for trading during the first two weeks, resulting in a total of forty ideas on the market. The cross-functional review team screened out twenty-two suggested ideas. Figure 2 illustrates the points in the market at which new securities were entered.

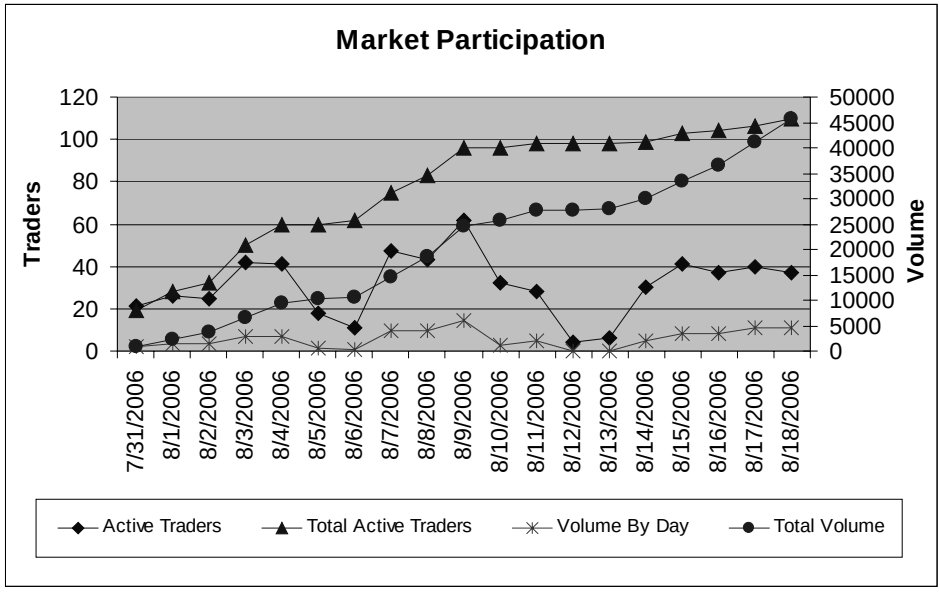

Figure 1: Participation Throughout the Market

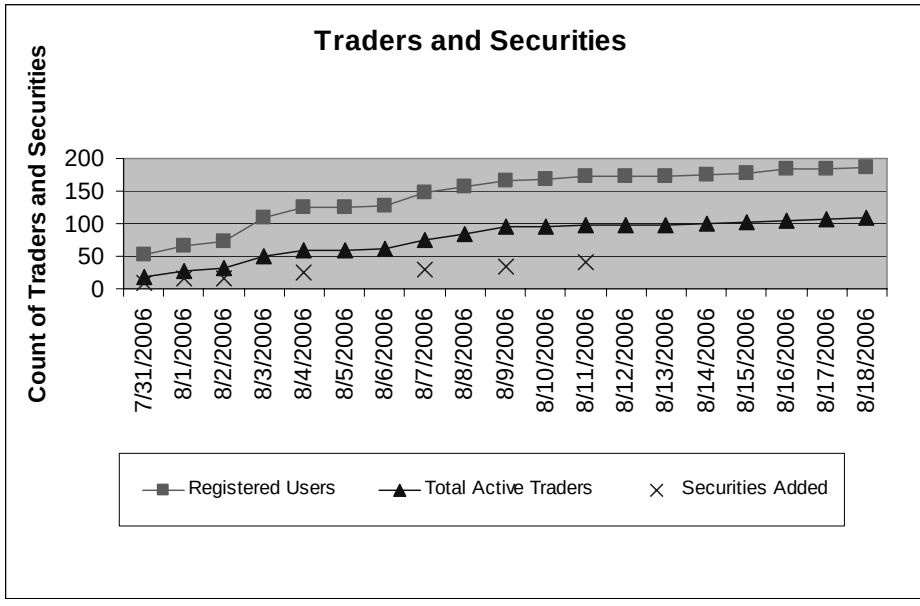

Figure 2: Security versus Trader Totals

b. Security Ranking

The final market results are shown in Table 2. Final price, total volume traded, and the number of individual traders who bought or sold the security are shown. The Initial Seed column indicates whether the idea was present at the start of the market (as indicated by a "Y"). Through the course of the market, a total of 45,652 shares were traded in 2,939 separate transactions.

Symbol	Final Price	Volume	Total Individual Traders	Initial Seed
D	98	2324	72	
FF	98	1910	64	y
H	89	2113	58	
Q	81	1082	57	
JJ	80	2144	48	
II	77	1614	50	
F	73	1178	57	
HH	69	712	43	
R	54	1071	54	
C	53	1042	54	
S	52	1165	56	y
KK	50	705	34	
O	50	1010	49	
EE	49	1350	52	y
NN	45	1358	59	y
MM	44	980	55	
Z	44	475	30	
E	42	931	50	
A	41	1215	53	
P	40	1453	58	
DD	36	1265	59	y
LL	36	710	39	
W	36	1367	53	
BB	35	1691	57	
I	35	741	37	
J	34	780	46	
N	34	689	41	
T	34	735	34	
G	33	819	54	y
X	32	974	52	y
Y	32	1205	50	
CC	29	1035	54	y
AA	28	876	48	
V	26	1120	48	
K	25	1655	58	
M	24	832	43	
B	23	987	37	
U	23	827	44	
L	22	857	47	
GG	21	655	40	

Table 2: Market Results - All traded ideas and final prices

Figure 3 displays the daily volume weighted average price (VWAP) for the top 5 securities based on VWAP over the last five days of the market. Although there were considerable fluctuations in pricing even at the end of the market, most of the top priced securities stayed consistently high throughout the course of the market. Most noteworthy, the two securities that tied for first place were in stiff competition throughout the duration of the market.

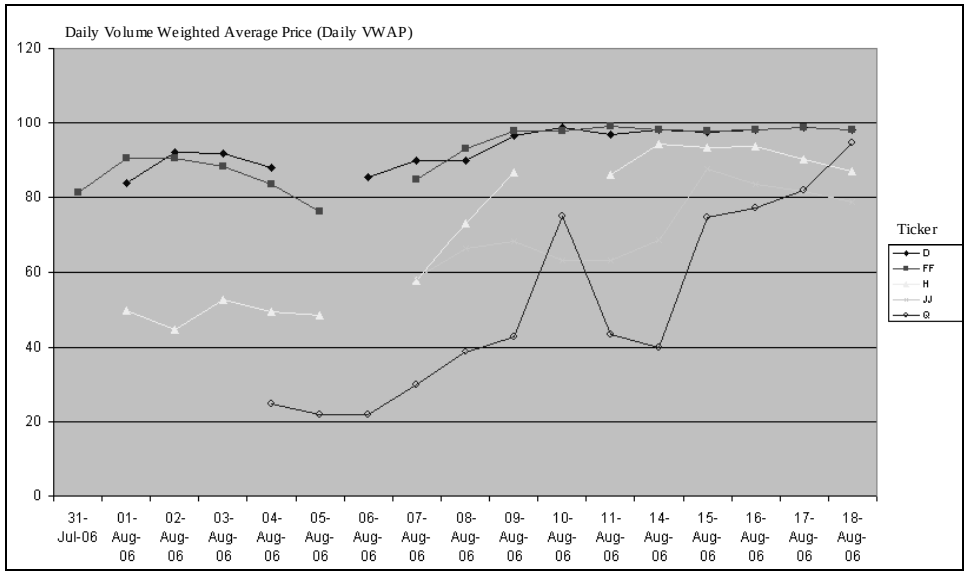

Figure 3: Daily volume weighted average price for each idea on the market

c. Idea Springboarding

The market mechanism allowed for a relatively large number of promising ideas to be generated in a relatively short time period. Further, a springboard effect was noted as ideas in the market tended to trigger submissions of related ideas that, in many cases, built upon the original submissions. Figure 4 shows a qualitative grouping of the ideas in the market by similarity. This grouping represents a subjective assessment by the product line management function of the sub-business, and no distance measures are meant to be conveyed in this graph. Ideas contained within the same circle represent variations of the same product line (for example, a red car versus a blue car). Ideas representing similar, but different product lines are connected by a dotted line, but not encircled (for example, a red sedan may be connected to a red van, but would not be connected to an airplane).

Clear winners were often selected from the similar groupings (shown in figure 4). For example, of the cluster involving securities C, X, DD, I, security C was the market's favorite, ending with a price of $50 compared to the others ending in the $30s. Further C had a negative correlation with each of the ideas as the market tended to buy more of C as X, DD and I were sold. Similar market reactions were seen in the JJ, LL, M, BB, O, W, KK cluster; the V, E, II cluster; the Y, HH cluster; and the F, S, R, Z cluster. Many new

ideas, or aspects of existing ideas, were proposed and openly discussed in the market forums.

In contrast to clustering the ideas based on a subjective assessment of the ideas and their relationships within product lines, we could consider grouping the ideas based on the buying patterns of the traders, grouping together those purchased by the same traders. There appeared to be little correlation between these two comparisons as traders tended to favor one idea over another in a given product line. For example, we examined the behavior of the traders as it relates to the ideas in the C, X, DD, I grouping and found only 35%, 40%, and 25% of the traders who purchased shares in ideas X, DD, and I, respectively, also purchased shares of idea C. When comparing C to an idea on the opposite side of our product-line-based cluster, such as idea CC, 30% of the traders who purchased idea CC also purchased shares of the idea C.

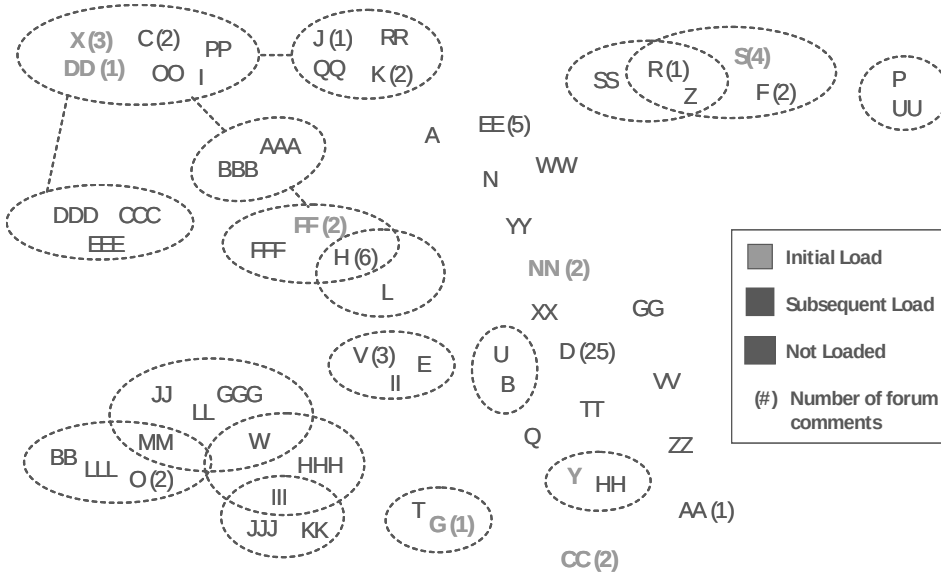

Figure 4: Idea Clustering - Many ideas seemed to be stimulated by existing ideas in the market

The highest overlap of traders was between O and S, where 12 (86%) of the 14 traders who purchased shares of idea S were part of the 30 traders who invested in idea O even though these two ideas were targeted towards very different product lines.

d. Founder's Behavior

One of the most interesting analyses we performed on our market data involved assessing selected participants' behavior. While it is difficult, if not impossible, to discern the intentions of a trader, the idea's submitter (or founder) is clearly motivated to have his idea valued highly by the market, both by the funding given to the top idea as well as the smaller prizes given to the top three ideas. There was also unstated potential for future funding opportunities as the market was run in conjunction with the business's annual budgeting process. The founders' trading activity is summarized in Table 3.

		Own Idea			Own Idea			Other Ideas (not submitter's)			Other Ideas (not submitter's)		
		Buys			Sells			Buys			Sells		
Symbol	Submitter	Price Prem	Shares	% tot vol	Price Prem	Shares	% tot vol	Price Prem	Shares	% tot vol	Price Prem	Shares	% tot vol
A	125							89.4%	15	0.0%			
B	169	136.7%	311	31.5%	87.5%	40	4.1%	116.3%	131	0.3%	101.4%	250	0.6%
C	51	109.6%	322	30.9%		0	0.0%				113.2%	550	1.2%
D	28	104.4%	648	27.9%	103.5%	450	19.4%	91.9%	171	0.4%	101.1%	734	1.7%
E	73	107.2%	110	11.8%	109.6%	118	12.7%	99.0%	1,608	3.6%	111.7%	1,928	4.4%
F	95	118.9%	68	5.8%							106.4%	60	0.1%
H	19	112.8%	763	36.1%	114.0%	358	16.9%	105.1%	334	0.8%	105.5%	917	2.1%
I	130	99.4%	40	5.4%	98.0%	55	7.4%	108.1%	2,793	6.4%	93.0%	4,458	10.2%
J	15	121.6%	50	6.4%				97.7%	130	0.3%	106.4%	195	0.4%
K	38				60.8%	15	0.9%						
L	146							100.3%	54	0.1%	93.1%	15	0.0%
M	78	143.0%	5	0.6%	195.1%	15	1.8%	107.9%	352	0.8%	125.9%	280	0.6%
N	126	120.4%	237	34.4%				106.8%	598	1.3%	87.3%	1,183	2.6%
O	20	106.2%	261	25.8%				117.6%	240	0.5%	89.5%	623	1.4%
P	45	126.7%	485	33.4%	84.0%	140	9.6%	123.3%	250	0.6%	84.2%	775	1.7%
Q	87												
R	62							91.8%	87	0.2%	97.9%	205	0.5%
T	154	129.5%	105	14.3%				120.7%	195	0.4%	93.8%	240	0.5%
U	48	104.6%	75	9.1%	84.9%	30	3.6%	109.9%	495	1.1%	96.3%	405	0.9%
V	8	87.4%	10	0.9%									
W	105	102.1%	20	1.5%	88.9%	25	1.8%	106.0%	348	0.8%	93.2%	190	0.4%
Z	61							102.8%	74	0.2%			
AA	130	136.3%	101	11.5%	101.1%	116	13.2%	108.1%	2,793	6.4%	93.0%	4,458	10.2%
BB	7							111.1%	25	0.1%	64.9%	43	0.1%
EE	4	122.3%	330	24.4%	96.4%	135	10.0%	125.0%	256	0.6%	91.9%	583	1.3%
GG	145	116.9%	31	4.7%									
HH	159	147.2%	312	43.8%				115.3%	371	0.8%	94.3%	831	1.8%
II	73	115.4%	561	34.8%	106.3%	448	27.8%	99.0%	1,608	3.6%	111.7%	1,928	4.4%
JJ	130	111.3%	865	40.3%	99.8%	671	31.3%	108.1%	2,793	6.4%	93.0%	4,458	10.2%
KK	61	93.8%	15	2.1%				102.8%	74	0.2%			
LL	85	100.8%	15	2.1%				102.0%	265	0.6%	116.0%	188	0.4%
MM	30	88.7%	45	4.6%				103.9%	278	0.6%	98.9%	245	0.5%
	Sum		5,785			2,616			16,338			25,742	
	Vol Wtd Average	116.8%			102.8%			106.6%			97.2%		

Table 3: Founder Trading Activity

"Price Prem" means price premium, % tot vol is percentage of total shares traded for the idea by the founder.

During the course of the market, a security's contribution to the player's portfolio was calculated as the VWAP over the last five days of trading. The submitter column shows the trader id of the idea's founder. The price premium column shows the percentage of the five-day VWAP at which the founder bought or sold that idea or other ideas and the shares column shows the number of shares of that idea or other ideas that the founder bought or sold. The volume weighted average row shows the volume-weighted average percentage of the five-day VWAP at which each founder bought or sold their

own idea or other ideas; it summarizes the overall price premium all founders as a group gave to their idea or other ideas. Table 3 contains only those securities that were proposed and approved for inclusion in the market.

In general, founders tended to buy their suggested ideas at prices above the VWAP in significant volumes. They tended to sell at lower frequency and volume. Founder activity with regard to other securities tends to fall into two categories: attempts to maximize the value of their own portfolio (buy low - sell high) or attempts to drive the prices of competing securities down at the expense of their overall portfolios' value, often manifesting itself as a buy high - sell low strategy. As an example, trader 130 took significant buy and sell positions in ideas FF (accounting for 11% of total trade volume), H (20% of total trade volume), F (16% of total trade volume) and B (37% of total trade volume) with what largely appeared to be an attempt to drive down the prices of these competing securities. Similarly, trader 19 participated in 19% of trades in security C. Overall, 29% of the traders were founders, and they were involved in 39% of all trades in ideas, including those that were not their own.

A one-tailed two-sample t-test comparing the price premium for a founder's own ideas versus the price premium that founders placed on others' ideas showed that owners' price premium is higher for their own ideas than for that of others' ideas (t-statistic (df=38)=2.17, p=.018). The difference between the founder's price premium when selling their own idea vs others' ideas is not significant (t-statistic (df=15)=0.43, p=0.67).

In Table 4, we examine the behaviors of the top five and bottom five traders. Those traders who were founders of ideas are denoted by the phrase "(founder)". In general, we would expect top ranked traders to trade profitably, i.e., buying low and selling high. For all top traders except trader 19, this appears to hold true. Conversely, we expect the lowest ranked traders to have been generally unprofitable, buying high and selling low. The bottom four traders were founders and the average ending portfolio value across all founders was $30,529 compared to an average of $32,556 for non-founder traders. The only founder in the top five was trader 19, who was able to purchase many shares of his idea early in the market and then take advantage of a large price run-up during the last week. Trader 19 was the founder of the third ranked idea.

In general, the founders exhibited a very different trading strategy than traders who did not propose ideas on the market. This behavior could be considered a form of 'wishful thinking' as discussed by Forsythe.[6] Forsythe found evidence in the Iowa Markets of behavior they termed 'wishful thinking' - the tendency of traders to perform irrational trades based on optimistic bias – thus making overly enthusiastic trades for preferred outcomes.

		Buys		Sells	
Trader	**Rank**	**Price Premium**	**Shares**	**Price Premium**	**Shares**
23	1	91.0%	6934	109.2%	5929
22	2	93.2%	6100	108.8%	6249
19 (founder)	3	110.3%	1097	107.1%	1275
5	4	96.2%	3225	105.9%	3297
11	5	77.9%	698	127.4%	325
36	182	110.2%	438	86.2%	757
20 (founder)	183	113.0%	501	89.5%	623
45 (founder)	184	125.4%	735	84.2%	915
126 (founder)	185	110.9%	835	87.3%	1183
130 (founder)	186	111.0%	1937	94.7%	2328
Total		97.3%	22500	103.9%	22881

Table 4: Behavior of Top Five and Bottom Five Traders

Another likely explanation is that founders have another incentive in trading. The reward associated with funding for the top idea introduces an externality that makes the behavior quite rational, even though it reduces a trader's portfolio value. It is also possible, that the monetary reward alone may not have been a sole motivator for the founders' behavior as there may be a psychological or social benefit associated with being the submitter of a top idea (even in spite of the anonymity of the market). This effect could be investigated further in future markets.

The important question raised is whether markets can still perform accurately despite overly enthusiastic trading on the part of this biased subset of traders. Despite this behavior, Forsythe asserts that the Iowa Markets produce efficient outcomes due to the effect of a few 'marginal' traders. He asserts that marginal traders are heavily influential in setting market prices. They appear to have a sound assessment of the fundamental value of a security, trade considerably more than most traders, and submit limit orders at prices close to the market price. Our market also had several traders who performed as marginal traders. Traders 22 and 23 performed considerably more trades than other traders on the market. Their trading was consistently rational as can be evidenced by the fact that these traders scored the highest in net worth at the end of the market. Their trades tended to be in the form of limit orders around market prices.

As an internal market, our market had considerably fewer participants and therefore less liquidity than in the Iowa Markets. Given this, a single trader may have a larger influence than was found on the Iowa Markets. Due to our lower participation, we may also have had fewer marginal traders to mitigate the effect of the biased traders. Table 5 shows that several founders performed a large percentage of the trades on their securities.

For six of the top ten ideas, the founder accounted for greater than 30% of all trade volume.

Symbol	Final Price	Volume	Total Unique Traders	Founder Volume	Founder Volume %
D	98	2324	72	1098	47%
FF	98	1910	64		
H	89	2113	58	1121	53%
Q	81	1082	57		
JJ	80	2144	48	1536	72%
II	77	1614	50	1009	63%
F	73	1178	57	68	6%
HH	69	712	43	312	44%
R	54	1071	54		
C	53	1042	54	322	31%
S	52	1165	56		
KK	50	705	34	15	2%
O	50	1010	49	261	26%
EE	49	1350	52	465	34%
NN	45	1358	59		
MM	44	980	55	45	5%
Z	44	475	30		
E	42	931	50	228	24%
A	41	1215	53		
P	40	1453	58	625	43%
DD	36	1265	59		
LL	36	710	39	15	2%
W	36	1367	53	45	3%
BB	35	1691	57		
I	35	741	37	95	13%
J	34	780	46	50	6%
N	34	689	41	237	34%
T	34	735	34	105	14%
G	33	819	54		
X	32	974	52		
Y	32	1205	50		
CC	29	1035	54		
AA	28	876	48	217	25%
V	26	1120	48	10	1%
K	25	1655	58	15	1%
M	24	832	43	20	2%
B	23	987	37	351	36%
U	23	827	44	105	13%
L	22	857	47		
GG	21	655	40	31	5%

Table 5: Founder Involvement in Market Securities

One of the top ideas, FF, was one initially seeded into the market and didn't have a specific founder, but subsequent investigation revealed that two major traders of this security were involved with thisproduct concept in its early stages and would benefit significantly from the award of the $50,000. Statistically, there is a strong positive correlation between founder trade volume and final price ($p<0.001$ by linear regression). The data also suggests that heavily traded securities with significant founder volume

tend to perform better, but significant founder volume alone is not sufficient to drive higher prices. It is not clear to what extent this can be attributed to networking outside the market mechanism or herding behavior within the market. It may even be coincidental that four of the top five ideas were both heavily traded and had a high degree of founder activity. Regardless, increasing participation would help limit the impact of founder influence; the more traders, the harder it is for any individual to shift security values (long term) in the market. It may also be that market exuberance for a founder's idea drives that founder to greater trading on that security.

Another interesting phenomenon in this market was the strong competition that arose between the top two ideas. The founders and interested parties of each idea were quite vocal during the market in pointing out potential trading improprieties of the other security (none of significance were actually found). Prices of the two securities were highly correlated as seen below (Pearson correlation of 0.970).

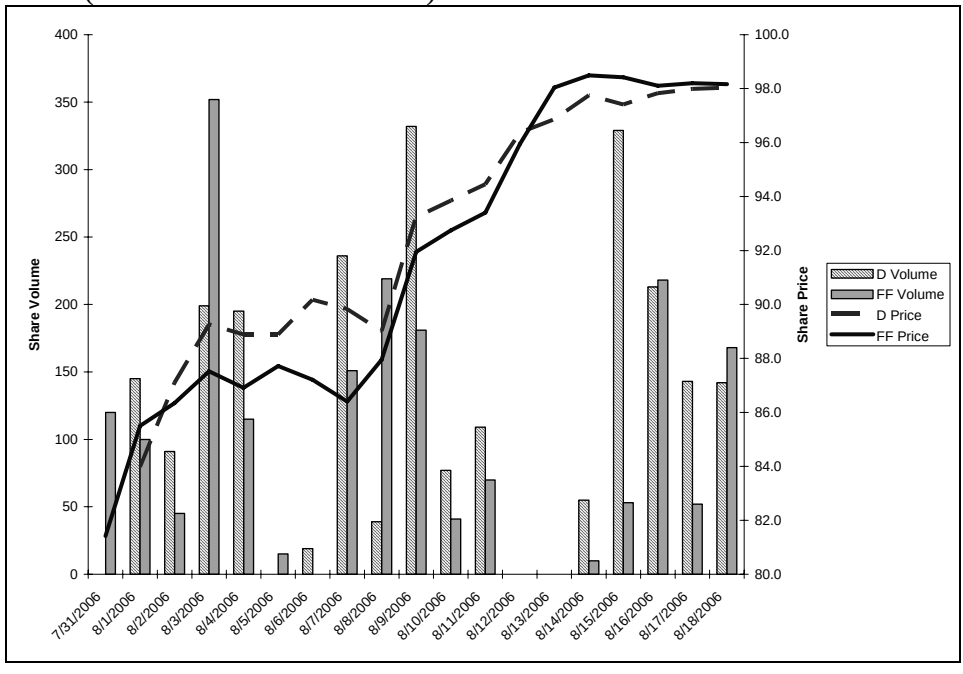

Figure 5: Price and Trading Volume for Securities D and FF

2. PARTICIPANT SURVEY RESULTS

Having witnessed behaviors in the market that could have influenced the results, we wanted to see how the market participants felt about the market

and its ability to accurately rank the given ideas. Clearly, an objective measure of market effectiveness is difficult, if not impossible to develop. To measure the real success of ideas requires business development and many years for sales and profits to be realized. To obtain a nearer term answer, an anonymous post market survey determined participants' opinion of ranking effectiveness. Due to the anonymous nature of this survey, specific responses of founders, or information regarding responses in relation to trader success is not available. This is noted as an area for investigation with future markets.

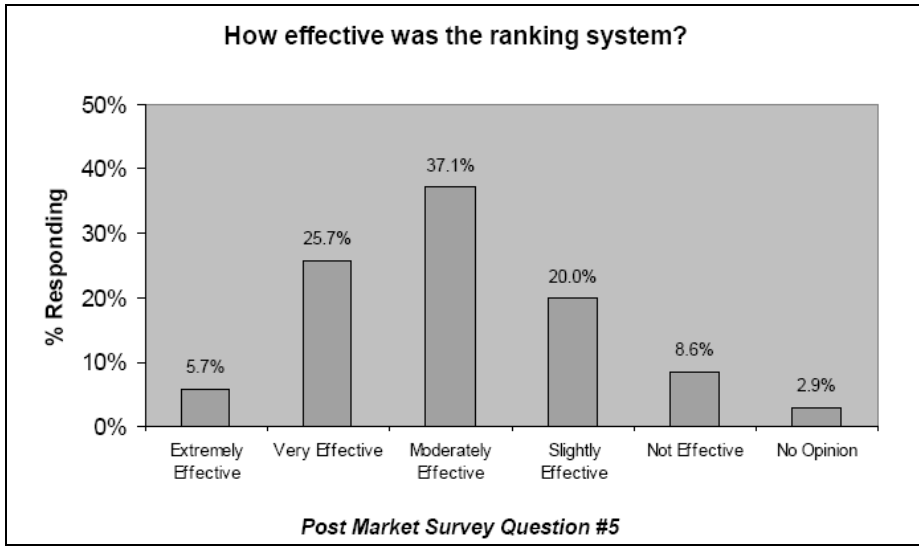

Figure 6: Survey Results on Ranking Effectiveness

Since the market is being used to aggregate the opinions of the entire group, it is not at all surprising that the participant survey yielded mixed results when asked about the market's effectiveness.

The survey results regarding the quality of the ideas were very positive, as shown in Figure 7. The overall quality of the ideas surpassed other idea generation and brainstorming activities GE Energy has tried in recent history.

Overall, in spite of the potential undue influence of founders, the market was successful in achieving GE Energy business objectives.

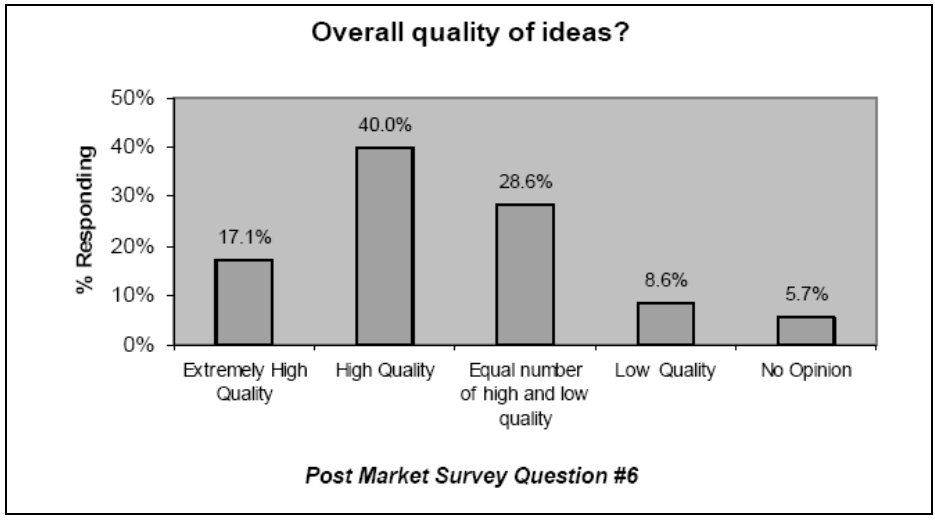

Figure 7: Survey Results on Idea Quality

3. MITIGATION STRATEGIES FOR FOUNDER'S BEHAVIOR

Having run several successful Imagination Markets within GE, we had not encountered such zealous idea founders before. The founder behaviors described earlier have been detected in some of our other markets, but not to the extent that they could have influenced the outcome. Now that we have witnessed this interesting behavior in full force, what market design changes or other strategies could we utilize to limit the influence of this kind of behavior?

1) Do not allow the founder to trade on his own idea: This option would unquestionably eliminate overzealous founder trading as it will change the trading motivation for founders. We thought, however, that participants would be more motivated to suggest ideas and compare them to other ideas if they could trade their own ideas. It would also not prevent friends or coworkers of the founder from overzealous trading on behalf of the founder. We can also reduce founder influence simply by not allowing the founder to *sell* any shares of their own security. This would allow them to profit from a good idea but not to aggressively trade by repeatedly buying and selling the same shares. However, the founder would not be able to sell any of his position (to buy another idea, say) if his idea's worth fell a lot. An alternative would be to limit the price for which the founder can trade. This may entail

allowing founders to trade on their own ideas only up to a pre-defined price, such as $80/share.

2) Capping the total amount of shares a given security can be owned by an individual trader: By capping the number of shares a trader can own of a given security, it prevents a single individual from owning a large percentage of the shares. It does not, however, prevent a founder from repeatedly buying and selling the same shares in order to keep the price up.

3) Capping the total amount of money that can be invested in a single security by a single trader: This would be similar to the effect of option 2 above.

4) Limit the number of shares a trader can submit for a limit order: Several founders were performing most of their trades by setting up very large limit orders at attractive prices. For example, if the security were trading around $95/share, the founder would place a Buy limit order of $96/share for 100 or more shares. This would ensure that they keep the Buy price up until their limit order was exhausted. By restricting the number of shares that can be placed as a limit order, and thus requiring them to spend more time reissuing their limit orders, we may be able to reduce the founders' trading.

5) Disallowing 'straddling' limit orders; or requiring the straddle have a minimum spread: Founders were also able to keep prices inflated by setting high-volume buy and sell limit orders which straddled the current trading price and differed by only a few dollars. Thus if the security was trading around $95/share, a founder would place an order to buy 100 shares at $94 and sell 100 shares at $96. This forced the price between these two thresholds until one of the limit orders was exhausted. Once exhausted, the founder could then issue another limit order to reestablish the straddle. Although similar to the behavior of a savvy trader playing fluctuations in the market, the founder's behavior differed in that their orders offered considerably more shares and had a tight spread between the bid and ask limit order prices. By requiring that the difference between the buy and sell orders be at least $10, we can make it much more difficult for founders to have such a heavy influence on trading. While it will not prevent their overzealous trading, it would likely reduce it. This would be less of an issue with thicker markets.

6) Eliminate motivation to zealously trade: Our market typically offers a reward for the best idea – either in the form of funding, or in the form of an opportunity to pitch the idea to the businesses leadership team. This provides motivation to the founder to influence the price of their idea, including trading to keep the prices up. As the purpose of the market is to identify and fund the best ideas, it is difficult to find a way to obtain good ideas without rewarding founders.

7) Reduce the amount of liquidity in the market: We can prevent founders from taking huge losses in order to increase the value of their security by eliminating any excess cash and allowance given to the participants. We suspect, however, that this would have limited impact since several founders on our market were so passionate that they liquidated their holdings in all other securities in order to raise cash to buy shares of their security.

8) Allow short selling: We chose not to implement short selling in our market since users found short selling difficult to understand in early market prototypes. As a result, traders have a limited ability to demonstrate that they feel a security is over-valued. If a trader believes the fundamental price is lower than the current market price, they can only sell their shares. Once done, that trader cannot further express his opinions through subsequent trades. If we allow short selling, traders could continue to express their opinion that a security is over-valued; this may help offset the exuberant trading by the founder.

9) Require founders to disclose their trades or all traders to disclose their trades once they buy more than some percentage of outstanding shares of an idea (similar regulations exist for financial markets). We already allow any trader to look at the transactions log and see the entire history but we haven't implemented any mechanism to alert other traders when a founder makes trades in his own idea or when any trader accumulates a certain percentage (note, however, that buying a lot of an idea's outstanding shares should not be very feasible unless the market has unusually few participants).

Finally, we should also acknowledge that restricting founders' behavior might not improve market performance. Presumably the founder of an idea knows more about the idea than other participants, so we may want them to play a big role.

4. CONCLUSIONS

Overall, the GE Energy business was extremely pleased with the results of the Imagination Market. Funding was immediately provided to kick-start the two ideas tied for the top, and the business has decided to file patents for several others. GE Energy plans to continue use of markets in the future. The volume and quality of ideas compared favorably to brainstorming sessions, on-line suggestion boxes, and on-line discussion forums. One of the keys to success for using a market as a brainstorming tool is having an active and engaged trading population. Further work will be done to find more and better ways to encourage higher participation.

Incentives proved to be useful and the seed money prize for best idea helped convince participants that the market was a serious tool for idea generation. The prizes for top performing portfolios may have caused some tournament behaviors, but they did help stimulate trading activity to improve liquidity. Incentives for the top ideas contributed to "founder" behavior. This behavior in of itself is not bad for the market, but care should be taken to ensure its influence is limited by larger participation in the market.

NOTES

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2. Chen, K, & Plott, C. (2002), Bingham, A. (2003), Kiviat, B. (2004), Hapgood, F. (2004).
3. Chan, N., Dahan, E., Kim, A., Lo, A. & Poggio, T. (2002), Feder, B. (2002).
4. iPod® is a trademark of Apple Computer, Inc.
5. James, D. & Issac, R.M. (2000).
6. Forsythe, R, Reitz, T. & Ross, T. (1999).

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C LaComb, J Barnett and Q Pan, "The imagination market" [July 2007] *Information Systems Frontiers* Volume 9, Issue 2-3. 245– 256.

APPENDIX 1: INSTRUCTIONS TO TRADERS AND SCREEN SHOTS OF APPLICATION

Upon logging into the Imagination Market application, the following instructions were given to market participants:

> *The Imagination Market allows you to trade securities that represent the different product breakthrough ideas proposed by your colleagues. Like the ideas your colleague proposed to generate revenue? Buy the idea's stock with your Imagination Market bucks. Have your own idea that could contribute to the bottom line? Propose it and if your colleagues buy in, your idea will be funded. The market aggregates the players' opinions and provides a single measure representing the relative value of each security: share price….*
> *Each player begins with $3,000. Active players also receive an additional $1,000 each week. When securities (ideas) are added to the market, each player will receive 15 shares at no cost. During the course of trading, you can buy or sell shares on any given security. If you like a security's idea, or believe the price is going to go up, buy shares from other players. If you do not like an idea, or believe the price is going to go down, sell your shares to other players. When the market is closed, each of your securities' worth will be determined by the volume-weighted average price (VWAP) over the last five days each security was bought or sold.*

In addition to this short set of instructions, a 3-page instructional manual regarding specific examples of trading strategies, as well as Market Rules, were provided to market participants. If you would like a copy of these documents, please contact the authors.

The following screen shots illustrate the manner in which the market and securities were presented to the users. Figure 8 illustrates the securities listing (idea titles have been replaced with ticker names for the purposes of this illustration). Figure 9 illustrates the trading page for a given security (description removed and idea titles replaced with ticker name for the purposes of this illustration).

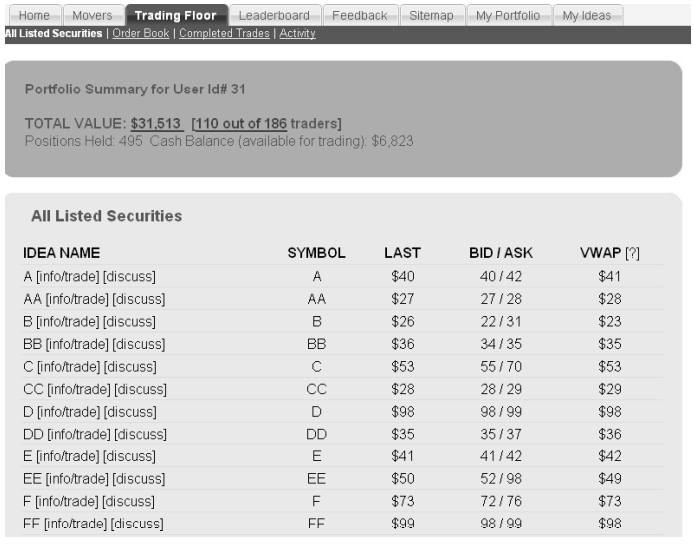

Figure 8 - GE Imagination Market Trading Floor

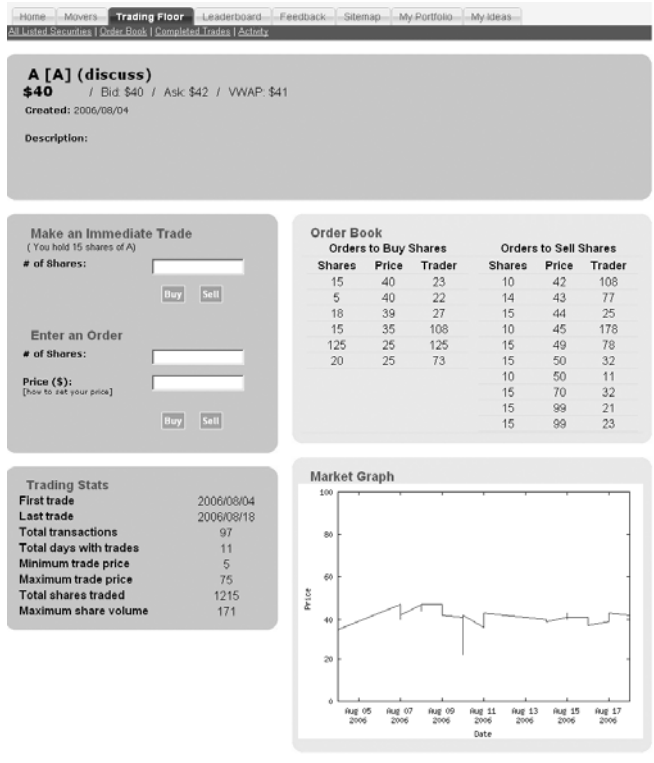

Figure 9 - GE Imagination Market Trading Page

The Journal of Prediction Markets (2009) ***3****,* 1 *41-44*

THE DESIGN OF IDEA MARKETS: AN ECONOMIST'S PERSPECTIVE[1]

Marco Ottaviani[*]

GE is pioneering the development of market-based methods for allocating research budget to internal projects. To be effective, a market for ideas must provide appropriate incentives for the *creation* of valuable ideas and it must result in sufficiently accurate *evaluation* of ideas.

The main tenet behind GE's Idea Market is that improvements in the evaluation of research ideas should foster incentives for idea creation. Indeed, idea creation and idea evaluation are complementary activities. For an idea to be successful, it is not enough that the idea be good. It also helps if the idea is recognized as good by those who evaluate it. As the evaluation process becomes more accurate, good ideas are more likely to be funded. Thus, incentives for the creation of ideas are enhanced when ideas are evaluated more accurately.

Consider first the incentives for the creation of new ideas. A key obstacle to the creation of ideas is the limited "appropriability" of their benefits (see Arrow, 1962). The problem is that good ideas can be easily stolen. As a result, inventors might have little if any incentives to come up with good ideas. There are non-market solutions to this market failure. For example, (open) science gives up on attempts to appropriate privately the benefits of ideas by making the ideas publicly available through the publication process. Creators of scientific ideas are rewarded instead by the public recognition awarded through the baroque reputation system we academics know all too well! In the case of GE's idea market, proponents of the idea with the highest price obtain valuable funding, internal recognition, and kudos.

Second, when it comes to the evaluation of ideas, the main challenge is making sure that the evaluators themselves have appropriate incentives to collect information about the quality of the ideas. To complicate the problem, the most competent evaluators are not always the most impartial—either

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because they stand to gain or lose from approval of the idea, depending on whether they are tied with or compete against the idea's proponent. The non-market solution used in science is mostly based on the peer evaluation system, whereby more senior or successful researchers are asked to evaluate the ideas of their junior colleagues. The underlying presumption is that good researchers are also effective and unbiased evaluators.

At GE, ideas are initially screened by a committee of experts, and then evaluated according to market prices resulting from trading among a broad set of company employees, including the proponents of the ideas. The research budget is then allocated to the idea with the highest price, providing a highly visible reward to the idea's proposer. Incentives for accuracy in the evaluation process are given by allocating small prizes to top traders. Traders are rewarded based on the value of their portfolio when the market is closed.

GE's idea market departs from regular financial markets (as well as from more traditional prediction markets) in two important ways. The first distinctive feature of idea markets is that the payoff of traders is not based on any ex post information on the quality of the idea selected. Regular financial markets—where there is a fair amount of ex-post validation, in the form of profits and dividends—are known to be subject to painful pathologies such as bubbles, fads, and herd behavior. These problems should be even more severe in the case of GE's financial marketplace, where there is no ex post validation on the quality of different ideas. GE's financial market is a textbook example of a pure "beauty contest," a game known to be riddled with multiple equilibria. If traders expect the price of one idea to be high (maybe just because this idea is "cool"), the price for that idea will be high, even though other ideas are much better.

Second, proponents of ideas are also allowed to trade on their own ideas. Actually, traders attempt very actively to bump up the price of their idea and so increase the chance their idea is eventually funded. Insider trading—typically prohibited in regular financial markets—is instead allowed and rampant in this market! It is then natural to expect the final prices to reflect the biases of proposers who are able to communicate (or hype) more effectively the content of their idea and/or to manipulate the market. These biases then reduce the accuracy of evaluations, which in turn dampens the incentives to create good ideas in the first place.

To address these two concerns, it would be worth introducing a "grain of truth" into these markets. Ideally, the payoff should be linked to measures of ex post performance of the idea implemented—even a very noisy profitability metric could provide some discipline to the market by anchoring expectations. Lacking any ex post measure of profitability, traders' payoffs in the financial market could be linked, at least partly, to a merit ranking of the ideas obtained

through other independent means (for example from the experts from the review panel). Because of this linkage, the danger is that market participants might have an incentive to second guess which ideas the review panel might think are profitable, rather than guessing profitability directly. Alternatively, one could think of running a set of two separate markets on the same ideas and reward participants of one market on the basis of the value of their portfolio evaluated with the final prices in the other market. (We refer to the analysis of Miller, Resnick and Zeckhauser (2005) on how to design incentives for information reporting in these environments.)

To curb insider trading and manipulation, the best solution is to encourage the amount and quality of participation by traders. Participation can be increased through better prizes and monetary incentives—and traders will have better incentives to be engaged if prizes are allocated through a lottery system, according to which each trader is awarded a number of lottery tickets proportional to the value of the portfolio of this trader relative to the value of the portfolio of all traders. Also, it would be natural to prohibit founders from taking positions on their own ideas (or to disclose which trades are made by founders).[2] Clearly, such regulations will not solve the problem completely because founders will still have an incentive to get their friends to help pushing up the price of their ideas. In addition, the potential drawback is that founders might be less engaged in the market—and might instead divert their effort to depress the price of competing ideas...

The design of idea markets is at its infancy. While we understand the role of many design parameters from our experience running other financial markets and institutions, idea markets can also provide economists with a fascinating laboratory for testing theories of incentives and behavior in organizations. Given the early stage of development in these markets, there is wide scope for conducting controlled field experiments. For example, it should be interesting to assess the effect of insider trading by running a parallel market in which idea proposers are not allowed to trade on the security corresponding to their own idea (or founders trades have to be disclosed), and then compare survey results in the two controls.

[2] The design of Nosco's Idea Exchange market seems much less prone to manipulation. There, traders cannot buy their own ideas. In addition, rather than automatically allocating the budget to the idea with the highest price, serious (subjective) consideration is given to the top ten ideas.

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HANSON'S AUTOMATED MARKET MAKER

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I. INTRODUCTION

ABSTRACT

From Hanson's "market scoring rule," we derive all the necessary formulae to implement a corresponding automated market maker for a prediction market. The market maker has many desirable qualities and always stands ready to trade, thus providing liquidity to markets. The formulae cover all transactions for buying and selling market contracts. In addition, we address practical concerns like how to correctly treat rounding errors and how to prevent errors that allow traders to cheat the market, and provide a practical numerical example. We have used Hanson's automated market maker to run many markets at Microsoft.

Motivation

Prediction markets usefully aggregate individual predictions into simple prices. Many studies demonstrate their accuracy in diverse applications, from predicting printer sales to predicting outcomes of political elections.

A prediction market works by creating contingent securities that represent the mutually exclusive possible outcomes of a future event. In its simplest form, the contingent security is worth some set amount if the outcome is realized, and it is worthless otherwise. For instance, a security contingent on the Green Party winning the next election might be worth $1 if the Greens win, but would be worthless if they lose.

Once the contingent securities have been created, market participants are free to trade those securities amongst themselves for some currency. Security prices reflect predictions of the likelihood of the contingent event—high prices indicate high estimated probability and low prices indicate low probability.

Two popular mechanisms exist for matching buyers and sellers in prediction markets: continuous double auctions (CDA) and automated market makers (AMM). In a CDA, the market maintains a list of Bids and Asks for each security. The Bids represent individual commitments to buy some number of shares of the security at given prices; Asks represent commitments to sell shares at a given price. Anybody wishing to purchase shares would

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check the lowest Ask price and either accept that price, or post a Bid to buy a lower price. In thinly traded markets, the spread between the lowest Ask and the highest Bid can be great—often too great to encourage trading. The complexity of the Bid/Ask process can also discourage traders from entering the market.

Market makers are traders that offer to buy or sell shares at prices with small spread. Market makers can exist with or without a CDA behind the scenes. Humans can set market maker prices, or computer algorithms can drive pricing. In either case, changes in trading behavior will drive market maker prices higher or lower.

An AMM allows traders to place all orders with the AMM, and the AMM determines the cost of each transaction and adjusts the prices of the securities. AMMs present many advantages to those wishing to implement a prediction market. An AMM can stand ready to trade at all hours, it can react instantaneously to changes in trading, and it can eliminate the unfortunate spreads found in thinly traded markets. To be useful, an AMM should have the following properties: the AMM algorithm should not be vulnerable to becoming a money pump to a clever trader; the AMM's potential losses should be bounded ahead of time; and the AMM should have tunable properties (e.g., how will a $1,000 bet affect prices?).

Fortunately, Robin Hanson invented the basis for an automated market maker that meets all these requirements when he invented "market scoring rules" (Robin Hanson, "Combinatorial Information Market Design" [2003] *Information Systems Frontiers 5:1* at pp107-119. Available at http://hanson.gmu.edu.).

There are many organizations that offer prediction markets both to the broader web community and privately. Some of the ones offering automated market makers of various kinds include:

Consensus Point (http://www.consensuspoint.com/)
Inkling Incorporated (http://inklingmarkets.com/)
Hollywood Stock Exchange (http://www.hsx.com/)
Hubdub (http://www.hubdub.com/)
Media Predict (http://mediapredict.com/)
Nosco (http://www.nosco.dk/)
Popular Science Predictions Exchange (PPX) (http://ppx.popsci.com/)
ProTrade (http://www.protrade.com/)
Qmarkets (http://www.qmarkets.net/)
Shuugi.in (http://shuugi.in/)
Spigit (http://www.spigit.com/)
Washington Stock Exchange (http://www.thewsx.com/)

Xpree Inc (http://www.xpree.com/)
Zocalo (http://zocalo.sourceforge.net/)

We go on to describe our internal implementation of Hanson's market scoring rule.

II. AUTOMATED MARKET MAKER FRAMEWORK

Hanson's Market Scoring Rule

Hanson's market scoring rule is based fundamentally on "proper scoring rules", which create an incentive-compatible way to reward accurate predictions of future events. Predictions take the form of probability estimates, and higher correct estimates are rewarded more generously than lower correct estimates. There are many proper scoring rules, all of which have the property that a rational estimator would maximize his expected return by revealing his true beliefs. This requires the score received to increase as the estimate of probability of the outcome (r_i) increases, such that the maximum possible score is received by truthfully revealing the probabilities of each outcome.

Hanson's market maker derives from the logarithmic scoring rule (Hanson 2003, p. 109):

$$score_i = b \log (r_i)$$

Here, r_i represents an estimate that event "i" will occur, and $score_i$ represents the score if that event happens. b represents a simple scaling factor. The highest possible score is 0 (when something is predicted with certainty $r_i = 1$), and the scores can be arbitrarily lower. Moreover, the logarithmic scoring rule is local, so the score of a given prediction can be computed based only on that prediction, independent of the predictions of competing events.

An Automated Market Maker

This scoring rule is easily turned into an automated market maker. A market consists of a set of mutually exclusive outcomes. Shares of the outcome that actually occurs are worth 1, all other shares are worth 0. The market maker sets the price of a given security based on the net amount of all securities outstanding. The more shares of an outcome that are outstanding, the higher the price of that outcome. If we assume that all securities start at the same price, and if we let s_i be the net amount of a given security that has been sold, then the price of security i is:

$$P_i = \frac{e^{s_i/b}}{\sum_k e^{s_k/b}}$$

It's trivial to see that these prices sum to 1, which we would require to eliminate arbitrage opportunities. From this formula, we can derive formulae for any transaction that the market maker might want to support: buying or selling securities, determining how much the price will move after a given transaction, etc. The market maker has many desirable qualities:

- The market maker stands ready to buy or sell an unlimited amount of any security, although the price of that security may be driven vanishingly close to 0 or 1.
- The market maker only risks losing a bounded amount of money. (All market makers risk losing money since they stand ready to buy or sell any security and only one of those transactions will make money.)
- The market maker cannot be turned into a money pump through clever sequencing of Buy and Sell transactions.

Unfortunately, creating a market maker from the price formula is not as simple as it might appear. That is because the prices change continuously as shares are traded—every fraction of a share that changes hands affects the price of the next fraction of a share.

The rest of this paper presents commonly needed formulae for implementing the market maker implied by this formula.

III. PRACTICAL FORMULAE FOR HANSON'S AMM

Formulae

The following symbols will be used for the various formulae:

a. s The stock vector. s_i represents the market's holdings of security i.

b. r The vector of "reports" (i.e., estimates) of a participant.

c. b The elasticity constant for the market. The greater b is, the less market prices change with each security purchase.

d. P The vector of prices of the securities prior to a transaction. P_i represents the price of security i. Prices are between 0 and 1, exclusive.

e. P' The vector of resulting prices of the securities after a transaction.
f. Q The quantity of a transaction (number of shares).
g. K The total cost of a transaction (amount of virtual currency).

Setting Initial Prices

This price formula above differs slightly from Hanson's by dropping the "a_i" offsets from the exponents. The purpose of those offsets is to set the initial prices of the securities. A simpler, equivalent way to set initial prices is to have the market patron make an initial "purchase" of securities that will drive the prices to the desired levels. This can be done with:

$$s_i = b \log(P_i) + X$$

where P_i are the desired initial prices, and X is any arbitrary constant. It is simpler in practice to start with no shares outstanding ($s_i = 0$), and all prices set equally. This creates an advantage for early traders, which in practice may be a desirable incentive to give traders to participate early. A third option is to allow traders to auction the right to enter the market first, or otherwise select preferred traders to fill this role.

Simple Transactions

What is the total cost of a transaction that would move the price of a security from P to P'?	$K = -b \log \frac{1-P}{1-P'}$
What is the total cost of buying Q shares of a security whose initial price is P?	$K = -b \log\left(P(e^{Q/b} - 1) + 1\right)$
How many shares of a security must be bought/sold to move the price from P to P'?	$Q = b \log \frac{P'(1-P)}{P(1-P')}$
How many shares of security can be bought/sold for a total cost of K?	$Q = b \log\left(\frac{e^{\frac{-K}{b}} - 1}{P} + 1\right)$
What will be the resulting price of a security after buying/selling Q shares of that security with an initial price of P?	$P' = \frac{1}{1 + \frac{1/P - 1}{e^{Q/b}}}$
What will be the result price of a security with an initial price of P after a transaction with a total cost of K?	$P' = 1 - \frac{1-P}{e^{-K/b}}$

The table above relates how prices, quantities and total cost are related in simple transactions. All signs are from the perspective of the market trader (units of currency and shares of stock received by the trader are positive, units of currency and shares of stock given out by the trader are negative).

Loss Limit

Market makers can lose money. Imagine that the correct security's original price is P and that traders buy as much of that security as they can and nothing else. The market maker would have to pay off each security for $1, but would have sold each for less than $1. The total difference represents the market maker's loss. The loss limit is:

$$L = b \log P$$

In some prediction markets, there is a set amount of money available for trading (*K)*. In this case, the market maker's loss limit is:

$$L = Q - K$$

$$= b \log\left(\frac{e^{\frac{-K}{b}} - 1}{P} + 1\right) - K$$

The greatest risk to the market maker derives from the lowest priced security initially.

Composite Bets

This market maker conveniently supports buying equal amounts of competing securities in a given transaction. To do this, simply use the combined prices of the individual securities as P in the preceding formulae. Of course, when shares of multiple securities are bought, the stock vector, s, must be updated for the appropriate constituents. If we let E be the set of securities that are to be bought together in equal amounts, then:

$$P_E = \frac{\sum_{i \in E} e^{s_i/b}}{\sum_k e^{s_k/b}}$$

Conditional Bets

This market maker conveniently supports conditional bets of the form, "if any event in W occurs then I win, if any event in L occurs then I lose, but if anything else (C) happens refund my money." Effectively, rather than

winning and losing outcomes there are also neutral outcomes. These bets are conditional in the sense that they are of the form "I bet that something in W happens given that it was something in $W \cup L$ that happens."

To create such a conditional bet, it is necessary to have a transaction that includes shares of securities in W to pay off a correct prediction, and shares of securities in C that will return the cost of the whole bet in case something outside of $W \cup L$ happens. To buy Q shares of this conditional bet, you must buy Q shares of W and just enough C shares to refund the total cost, K. In other words, there must be exactly K shares of C, so that if C ends up including the correct outcome, the trader receives just enough of a benefit to offset his initial cost K.

Fortunately, it is easy to determine the price for this conditional bundle of shares. Use the standard formulae above with the following price:

$$P_{W|W\cup L} = \frac{\sum_{i\in W} e^{s_i/b}}{\sum_{k\in W\cup L} e^{s_k/b}}$$

*How to Set **b**?*

The elasticity constant b controls how much prices change for a given transaction size (measured in shares or cost). Setting b is a vexing problem: set too low, the market prices will swing wildly on any trade, and set too high, the market may not move enough reasonably reflect aggregate opinions.

The simplest rule of thumb is to determine how large a bet should move the market to a given price. For instance, if $1,000 is bet on some security and nothing is bet on any other, it may be desirable for the price of that security to move to $0.99. (I.e., a $1,000 bet would only be made if the bettor had 99% confidence in the underlying event.) This leads to:

$$b = \frac{-K}{\log\frac{1-P}{1-P'}}$$

Note that the original price, P, for this computation is typically the starting price for all N securities, which is $1/N$.

*Adjusting **b** When the Market is Open*

For some markets, it is impossible to know how much money will be wagered, which makes it difficult to pick an appropriate amount of elasticity that works throughout. In this case, it is helpful to be able to pick a small b (high elasticity) and then adjust as more money is brought into the market.

Adjusting b presents two challenges. First, changing b without changing anything else will change all of the prices. (Recall that prices are a function of the stock vector and b.) Second, the elasticity affects market maker risk—increasing b will increase the loss limit for the market maker.

To change b without affecting market prices, the market maker must purchase enough of each security to maintain the pre-change prices. This can be accomplished using the same formula used to set initial prices:

$$s_i = b \log(P_i) + X$$

With this formula, simply set X to minimize the number of shares that the market maker must buy, and then buy the shares needed.

The new risk of market maker losses is determined by the loss limit at the current market prices minus the market maker's net balance from previous sales.

IV. PRACTICAL CONSIDERATIONS BEYOND MATH

While the formulae that drive the market maker are essential to any implementation, there are other practical concerns.

Stock Vectors

Any market maker implementation must keep an accounting of the state of the market. This accounting is simple:

- The market maker must keep track of its net position in each security. I.e., how many shares of each security are outstanding.
- The market maker must know the elasticity constant, b.

Strictly, speaking the market maker could keep track of prices rather than shares, but that can often present problems with rounding numbers, since in practice it is easy to constrain the number of shares to an exact value, but harder to constrain the price changes.

Prices

In our experience, many people do not feel comfortable with prices ranging from 0 to 1, and are much more comfortable with 0 to 100. To accommodate prices in a range $(0, c)$ it is necessary to replace amounts of currency with their scaled equivalents, i.e. P with P/c, and K with K/c in all

of the preceding formulae. See the practical numerical framework section below for the modified formulas.

Short Sales

In our experience, many people wish to enter into *short* sales—selling shares they don't own, but presumably believe are overpriced. The market maker supports short sales.

Although technically supported, there is one practical reason why some markets disallow short sales. Short sales create a liability on the part of the seller to cover that sale some day. This adds complexity to the overall trading platform, and creates the need for more policies to govern the degree to which short sales must be "covered."

To avoid short sale issues, we encourage presenting traders with the ability to "bet against" a security by buying a bundle of an equal number of all other securities.

Rounding

If not handled properly, the rounding of floating point numbers on a computer can create possible ways to pump money out of the market maker by creating a sequence of trades that round in the trader's favor.

Avoiding these errors is straightforward. First, the market must define the precision at which shares are traded. For instance, whole shares, shares to two decimal places, etc., can be supported. Similarly, the market must define the precision at which money is traded. The internal precision at which shares and money are traded may be greater than that displayed to the trader, in which case the trader sees a truncated or rounded representation of the actual value. (There is a risk of trader confusion when actual and displayed precision differ, however.)

Once the precision has been decided, the following rules must be obeyed:

- Use share quantities as the fundamental units for any transaction.
    - For purchases from the market maker, round quantities down to the precision.
    - For sales to the market maker, round quantities up to the precision.
- Once share quantities have been computed, compute total costs.
    - For purchases from the market maker, round costs up to the precision.
    - For sales to the market maker, round costs down to the precision.

Share prices need not be rounded up/down if the market maker charges a "transaction fee" that exceeds the precision of money in the system.

Turning Currency Into Something of Value

Sometimes prediction markets employ virtual currency in lieu of real currency, which may subsequently be turned into something of value. Whatever scheme is employed, it is important to preserve *incentive compatibility*, i.e. a trader's incentive should always be to tell the truth to maximize his reward. One hazard is the inadvertent creation of *tournament incentives*, where a trader is rewarded for making risky predictions that do not necessarily represent his true beliefs. Rewarding the top N traders in a market creates tournament incentives that are not incentive compatible. Since the primary goal of prediction markets is to make accurate predictions, we strongly advise caution in this area.

An incentive compatible alternative is to convert market currency into raffle tickets, and then award prizes by lottery. However, in our experience this can be quite frustrating to traders when prizes are won by traders with small balances. We sometimes compromise by offering two prizes per market: a large prize awarded by lottery, and a smaller prize that goes to the "top trader" in the market. A small tournament incentive is present, but the larger lottery prize discourages risky behavior and preserves overall incentive compatibility. Similarly, simply publishing rankings creates tournament incentives among competitive traders.

Setting and Adjusting Market Maker Elasticity

Determining a desirable elasticity for the market maker is difficult. If a market is too elastic, traders will observe wild price fluctuations. If a market is not elastic enough, traders are frustrated by the relatively static prices.

As discussed above, our approach has been to make an estimate of the participation we expect for a market, then to set the market maker elasticity so that if all active traders predict the same outcome with all of their currency, the price for that security is driven to a fixed value. Unfortunately, estimating the participation is difficult for new markets.

We are currently deploying markets that adjust their elasticity as trader capital enters the market. We limit the size and frequency of the changes to avoid creating the perception among traders that the market is changing radically. When the elasticity changes, the market maker adjusts the stock vector to keep prices from changing.

Encouraging Participation

We often observe large spikes in trading activity right after a market is created or a reminder sent, followed by low trading activity until the next reminder. To increase participation (without creating perverse incentives) we now reward visits to the market web site itself, regardless of resulting trading behavior.

V. PRACTICAL NUMERICAL FRAMEWORK

When implementing an automated market maker, we need to take everything discussed above into account, including the inaccuracies of floating point representations and computations. We add in the scaling factor *c*, which represents the maximum price for a security, most commonly 1 or 100 (both have been used at Microsoft). Adjusting the math for this results in:

What is the total cost of a transaction that would move the price of a security from P to P'?	$K = -bc \log \frac{c - P}{c - P'}$
What is the total cost of buying Q shares of a security whose initial price is P?	$K = -bc \log \left(\frac{P(e^{Q/b} - 1)}{c} 1 \right)$
How many shares of a security must be bought/sold to move the price from P to P'?	$Q = b \log \frac{P'(c - P)}{P(c - P')}$
How many shares of security can be bought/sold for a total cost of K?	$Q = b \log \left(\frac{c(e^{\frac{-K}{bc}} - 1)}{P} + 1 \right)$
What will be the resulting price of a security after buying/selling Q shares of that security with an initial price of P?	$P' = \frac{c}{1 + \frac{c/P - 1}{e^{Q/b}}}$
What will be the result price of a security with an initial price of P after a transaction with a total cost of K?	$P' = c - \frac{c - P}{e^{-K/bc}}$

We'll set prices scaled to *c*:

$$P_i = \frac{ce^{s_i/b}}{\sum_k e^{s_k/b}}$$

Running a market requires us to pick a value for b, which we can do using the method described above for a market with N possible outcomes (and thus N securities). Given a total expected flow of capital into the market of K, and

a desired upper price target if all of this flows into one security of Pupper, we will use:

$$b = \frac{-K}{c \log \frac{N(1 - \frac{P_{upper}}{c})}{N - 1}}$$

VI. PRACTICAL NUMERICAL EXAMPLE

We present a market example, do all the math to six digits after the decimal point and use the natural logarithm. Consider a market designed to estimate the probability of four possible outcomes for sales of product X in calendar year 2009:

A. Sales < 1,000,000 units
B. Sales ≥ 1,000,000 units but < 1,500,000 units
C. Sales ≥ 1,500,000 units but < 2,000,000 units
D. Sales ≥ 2,000,000 units

We refer to each contingent security here using the letter assigned to it (A, B, C or D). The four possibilities (N = 4) are mutually exclusive, and in practice should be anchored to a real-world event, which in this case might be the official sales result report released in January, 2010. In this example, we scale our prices so that securities float between \$0 and \$100 (c = 100). After the real-world event occurs, each share of the security representing the outcome that occurred is worth \$100, and each share of the other securities is worth \$0.

Each trader will start with \$10,000 in virtual dollars. The only thing left to determine is the value of b to select for the market. Make b too small, and the market prices will move too easily. Make b too large, and traders will be frustrated by their inability to influence the market prices. In this example, we are expecting 20 active traders from the pool of invitees. We set b so that if all 20 traders invest everything in one outcome, the price of that security will rise to \$99:

$$b = \frac{-K}{c \log \frac{N\left(1 - \frac{P_{upper}}{c}\right)}{N - 1}}$$

$$= \frac{-(20 * 10000)}{100\log\frac{4\left(1-\frac{99}{100}\right)}{4-1}}$$

$$= 463.232312$$

We now open our market with all prices set to *c/N*, which in this case is 100/4 = \$25, so P_A = \$25.00, P_B = \$25.00, P_C = \$25.00 and P_D = \$25.00. Now our first trader asks to purchase \$5000 worth of security B, so we need to calculate how many shares that is, where *K* represents the total change to the trader's cash balance (-\$5000):

$$Q_B = b\log\left(\frac{\mathrm{c}\left(\mathrm{e}^{\frac{-K}{bc}} - 1\right)}{P_B} + 1\right)$$

$$= 463.232312\log\left(\frac{100\left(\mathrm{e}^{\frac{5000}{463.232312*100}} - 1\right)}{25.000000} + 1\right)$$

$$= 174.004846$$

To prevent rounding errors from causing cash-positive transactions that should not be ("cash pumps"), we round the number of shares awarded down as discussed above, in this case to 6 digits after the decimal point. Since the amount of currency is exactly \$5000, we do not need to round it up. Note that there are many transactions supported by this model, including multiple simultaneous purchases, and that we are illustrating only a simple single-security purchase and sale here. We then calculate the new price for each security given the outstanding stock sold by the market maker so far (s_A = 0, s_B = 174.004846, s_C = 0, s_D = 0):

$$P_A = \frac{ce^{\frac{s_A}{b}}}{\sum_k e^{s_k/b}}$$

$$= \frac{100e^{\frac{0}{463.232312}}}{e^{0/463.232312} + e^{174.004846/463.232312} + e^{0/463.232312} + e^{0/463.232312}}$$

$$= 22.442099$$

$$P_B = \frac{ce^{\frac{s_B}{b}}}{\sum_k e^{s_k/b}}$$

$$= \frac{100e^{\frac{174.004846}{463.232312}}}{e^{0/463.232312} + e^{174.004846/463.232312} + e^{0/463.232312} + e^{0/463.232312}}$$

$$= 32.673702$$

$$P_C = \frac{ce^{\frac{s_C}{b}}}{\sum_k e^{s_k/b}}$$

$$= \frac{100e^{\frac{0}{463.232312}}}{e^{0/463.232312} + e^{174.004846/463.232312} + e^{0/463.232312} + e^{0/463.232312}}$$

$$= 22.442099$$

$$P_D = \frac{ce^{\frac{s_D}{b}}}{\sum_k e^{s_k/b}}$$

$$= \frac{100e^{\frac{0}{463.232312}}}{e^{0/463.232312} + e^{174.004846/463.232312} + e^{0/463.232312} + e^{0/463.232312}}$$

$$= 22.442099$$

So the purchase transaction moved the market prices of A to $22.44, B to $32.67, C to $22.44 and D to $22.44. Note that although we may display the prices rounded to the nearest penny, internally we always compute them from the stock vector, which is an exact representation of the number of shares

outstanding, and maintain higher precision for internal calculations. In this way we avoid cumulative rounding errors, which can be a big problem over large numbers of transactions.

Now suppose the same trader wishes to sell his stake of 174.004846 shares of B. Since the number of shares is exactly 174.004846, we do not need to round it up. We compute the amount of money this stake is worth, rounding the amount of currency awarded down to prevent cash pumps as before:

$$K = -bc \log\left(\frac{P_B\left(e^{\frac{Q_B}{b}} - 1\right)}{c} + 1\right)$$

$$= -463.232312 * 100 * \log\left(\frac{32.673702\left(e^{\frac{-174.004846}{463.232312}} - 1\right)}{100} + 1\right)$$

$$= 4999.999916$$

Note that our rounding to avoid cash pumps intentionally destroyed \$0.000084 of currency for the trader with this purchase and subsequent sale. If instead we allowed minute fractional positive cash flow, then we would be subject to scripted attacks that generated cash. Just like share prices, the logical thing to do is to display the rounded value of \$5000.00 to the user, meaning that the loss of minute fractions of cash would only become visible to a trader after many such transactions. We have not seen this in practice.

Finally we compute the new prices of each security given the outstanding shares of each security ($s_A = 0$, $s_B = 0$, $s_C = 0$, $s_D = 0$) in the same way as above, which results in a return of the prices to P_A = \$25.00, P_B = \$25.00, P_C = \$25.00 and P_D = \$25.00.

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ON MARKET MAKER FUNCTIONS

Robin Hanson[1]

Since market scoring rules have become popular as a form of market maker, it seems worth reviewing just what such mechanisms are intended to do.

The main function performed by most market makers is to serve as an intermediary between people who prefer to trade at different times. Traders who have the same favorite times to trade can show up together to an ordinary continuous double auction, and then make and accept offers to trade. But when traders have different favorite times, a market maker can help them by first making offers that some of them will accept, and then later making opposite offers which others will accept. By adjusting prices in his favor, a market maker can even profit from providing this service.

By making offers, however, a market maker opens himself up to the risk of losing to informed traders who know more than he about asset values. It is a complex and difficult task to choose the price and duration of offers in order to profit the most from intermediary trades while suffering the least from informed trades. This task requires subtle judgments about the relative fraction of informed and intermediary trades at different times, prices, quantities, and trading histories. No simple algorithm could reasonably claim to do this task optimally.

Very active markets have little need for market makers, as anyone can trade at anytime. In markets with large but sporadic trades, a human will likely find it profitable to apply their considerable intelligence to the complex task of market making. The question is what to do for smaller less-active markets, which cannot afford such human attention. Trading may simply not happen there if no intermediary can be found to make such markets.

A computer program with less than human intelligence that attempts to make markets runs the risk of being out-smarted by human traders. Humans might even figure out how to turn that program into a money pump, giving up cash each time it is run through some cycle of trades. Of course a program could be set to shut down once it had lost more than some amount, but then it would no longer be making markets.

In this difficult situation it is somewhat comforting to know that we can at least describe a simple program that is guaranteed to always intermediate

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trades by offering substantial buy and a sell offers close to each other in price, and that can do so forever while bounding the amount of money that it could ever lose. While such a program will rarely do an optimal job of trade intermediation, it will at least support some trading.

This simple automated market maker is inventory-based. That is, it always sets its current buy price to be some monotonic function of its asset holdings, and always offset from its sell price so as to prevent becoming a money pump. I was not the first to realize this result (Savage 1971; Black 1971). If I made an original contribution it was to describe combinatorial versions of such market makers (Hanson 2003; 2007). Given some set of base events, a combinatorial market maker can support trades between any combination of event-contingent assets defined in terms of events expressible as any combination of these base events.

This sort of market maker, one that can both guarantee perpetual trade intermediation and yet bound its losses, is the sort that a neutral exchange could reasonably support directly. More ambitious market maker programs must take more risks, and so need to be monitored more closely to ensure that they are sustainable and do not covertly favor some traders over others. Fortunately multiple market-makers can coexist within a continuous double auction market; one can support both a safe inventory-based version and also more ambitious but risky versions.

In addition to firms like Microsoft that have constructed their own simple inventory-based market makers, several firms, such as Consensus Point, Xpree, and Inkling, now sell software that support such markets. Software engineer Ken Kittlitz of Conensus Point writes about their experience:

> "Having run markets both with and without Hanson's automated-market maker, we say with confidence that it makes a huge difference to the success of a market. Because it maintains buy and sell orders at a wide range of prices, it provides a steady source of liquidity that would otherwise be lacking. This allows traders to interact with the system in an easy, intuitive manner rather than having to worry about placing booked orders at certain prices and waiting for other traders to match those orders. The number of trades in a market using the market-maker is at least an order of magnitude higher than in one not using it."

A few firms, such as YooNew, have even implemented combinatorial versions of inventory-based market makers, and Consensus Point will soon sell combinatorial software.

There are two obvious ways that an inventory based market maker can fail to optimally intermediate trades: it can trade too much or too little, via offering too much or too little liquidity. If it offers to trade too much, it may end up trading mostly with only one side of the market (e.g., buyers), as the price might not move enough to engage trades on the other side. If it offers to trade too little, then those who want to trade more will have to wait, either for others to accept direct trader-to-trader offers, or for the market maker to return to their price range. Of these two errors, trading too little is the cheaper risk.

One can modify a simple inventory based market maker to use different price-inventory relations in different circumstances, and in this way adapt its liquidity to apparent demand. But this approach risks unbounded losses to clever traders who anticipate and exploit such changes. For example, if a clever trader can anticipate that low liquidity will be followed by high liquidity, he might suffer small losses while moving the price far away, but then be rewarded with large gains for returning the price back to its starting point.

While trade intermediation is usually the main function market makers are created to perform, it is worth mentioning that market makers can perform other functions. In particular, market makers can encourage trading activity. Losses of a market maker are gains to its traders, and the prospect of such gains should entice more trading. The details of the added trader incentives match details of the market maker's loss tendencies.

A nice feature of inventory-based market makers is that they only directly reward traders for acquiring more information about asset value. No other trading activity is rewarded directly, though other activity can be rewarded indirectly via the combination of the market maker and other traders. For example, traders are rewarded for acquiring information before other traders, traders can have incentives to trade to mislead other traders about their information, and traders may want to wait for trades with complementary information before making their own trades.

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INKLING: ONE PREDICTION MARKET PLATFORM PROVIDER'S EXPERIENCE

Adam Siegel*

ABSTRACT

This article presents a prediction market vendor's experience in providing publicly available and private play-money prediction market services to international corporations and other organizations. We describe why our experiences as IT and management consultants drove us to start the company and give an overview of the successes and pitfalls our clients have encountered during their prediction market trials. We also discuss several lessons learned we share with our clients in the areas of participation, incentives, communications, and appropriate questions to ask and explore why some prediction market pilots fail while others succeed.

1. INTRODUCTION

An IT project manager at a mid-size energy company knew he had a problem. Windows Vista was being rolled out to the entire organization (10,000 people) and the project was behind schedule and slipping further. Budgets were already in the red and no one was sure if there were enough resources to complete the project. Compounding the problem for the project manager, three separate vice-presidents in the company were responsible for the project and their direct lieutenants were keeping them in the dark about the magnitude of the problems the project was facing.

Going above several layers and speaking directly to the vice-presidents was political suicide and getting anyone else to sit them down for an honest conversation was simply impossible. The IT manager told us he was left with the following options for getting the help he needed to get the project back on track:

- Do nothing and hope the project recovers
- Contact the vice-presidents anonymously with supporting information

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- Mask the problem by requesting more funding to hire consultants who could hopefully right the project

Ideally if someone with decision making authority and budget oversight were aware of the problems the project was facing, they could provide more funding, re-organize the team, or simply reduce the scope of the project and extend its deadline while providing political cover from the rest of the organization.

The IT manager knew the corporate culture driving this problem was a larger fight for another day. In the meantime he needed a credible and convincing way to convey the magnitude of the problem without facing the firing line by himself or getting anyone else in trouble.

He needed a prediction market.

a. The Rationale For Inkling

Consulting for some of the largest companies in the world over a 10-year span gave us deep insight in to how a modern day company operates. We were fortunate to work for telecommunication companies, financial institutions, state and federal governments, automotive companies, chip manufacturers, and media and entertainment companies, but more importantly we were exposed to all levels and areas of these companies, from IT to finance to product development, from customer support representatives, to programmers, to CEO's, CFO's, and CIO's. While we didn't fully comprehend what we were seeing at the time, we did notice some disturbing trends:

- Office politics were rampant in every company we worked;
- We spent too much time "spinning" information on behalf of our stakeholders;
- Larger companies had byzantine-like organizational structures making collaboration exceedingly difficult;
- Millions were spent on collaboration and knowledge management technologies that were under-utilized or poorly designed in the first place;
- Useful information existed in isolated pockets of the organization. The dots were rarely connected.

With the onset of "crowd-driven" and "do it yourself" trends in the consumer space, we began to think about these problems differently. After reading James Surowiecki's book, "Wisdom of Crowds" we had our "a-ha"

moment about what our prescription should be: internal prediction markets with a "do it yourself" twist.

However, while Surowiecki and others in the space were focusing on more accurate forecasts being the primary benefit of prediction markets, coming from our consulting backgrounds we thought of them differently. More accurate forecasts are a benefit, but the insight gained of what people in the company *perceive* will be the outcome (even though they may be absolutely wrong in their predictions,) and *exposing* those perceptions may be just as important.

The best managers we've seen and read about ask many questions and implore their employees to vocalize issues as early as possible before they become unmanageable. We decided prediction markets could serve as an "early warning system" for the company, giving managers insight in to potential issues and allowing them to take action much earlier than they had been able to in the past. This is why in Inkling, for example, we allow anyone to ask their own question and strenuously encourage our clients to allow this function to be available. The more questions asked and the more input informed employees can give, the better.

Prediction markets in a corporate context stress making information more transparent and attacking internal political machines. Those who have survived in their companies by mastering this game will offer the most opposition to the introduction of prediction markets because they are suddenly losing control of information they used to be able to manipulate. But even these people have an opportunity to come out ahead if they use the information the prediction markets provide to be more effective managers.

b. Our Experience

The analysis in this paper is based on our experience running or witnessing thousands of private and public markets. The reader can get a sampling of these markets at our public market place, http://home.inklingmarkets.com

All of our markets make use of an automated market maker, a computer algorithm that allows traders to always complete a buy or sell order. The market maker, which uses Robin Hanson's Market Scoring Rule (described in more detail in the Berg et al and Hanson papers in this issue,) allowed us to introduce a simplistic trading interface that could be understood by the general public and employees at all levels and skill sets in corporations. This decision has born out time and again culminating in our largest marketplace to date: CNN's 2008 Political Markets which saw close to 3 million trades by 55,000+ traders in only 9 months of activity.

2. BUSINESS BENEFITS REALIZED

While we had inclinations of how businesses would use prediction markets, we have also learned from innovative managers in companies who have thought of their own use cases. Using actual questions our clients are running in their marketplaces, we've outlined four business processes to show where prediction markets have made a positive, but non-traditional impact.

a. Research and Development Resource Allocation

A common problem in large companies is quantifying the value of research projects, especially those directly related to product development vs. empirical research. One manufacturer with a several hundred million dollar research budget said they needed a credible way to *cancel* projects that had become money pits.

Example Questions	Participants	Value
• Will project X be included in a production-level product by X date? • What will be the actual budget required for project Y in FYxx? • Will idea X fulfill cost/benefit analysis requirements? • Will a prototype of X meet defined success metrics?	R&D, Product development teams, marketing, select field offices, corporate strategy	• Resources can be re-allocated based on predicted business impact; • Transparent and inclusive process helps removes politics from resource allocation • Focus returns to allocating resources according to success probability • Broader audience feel they have "skin in the game" in the direction of product development

b. Monitoring and discovering strategic risks and trends

Most companies perform an annual risk audit in preparation of their 10-k SEC filing statements. This is an excellent resource to use to run markets about company-wide risk factors and their symptoms. We also suggest companies be as open as possible about allowing their employees to think of

and run similar type markets. A "web" of questions asking about potential risk factors can be a very powerful risk mitigation tool.

Example Questions	**Participants**	**Value**
• Short term and long term questions about topics such as: o Supply chain interruption / inefficiencies o Healthcare costs o Raw material costs o Regulatory / legislative environment o Budget projections	Company-wide	• Understand viewpoint of risks from diverse sources • Have better control over internal and external messaging related to risks • *Everyone* is made aware of risks company-wide which changes behavior to address them • Discover risks not previously identified through formal risk audits • Regardless of accuracy of prediction, consensus provides insights in to collective thinking • Augment existing risk models and consulting advice

c. Competitive Intelligence

Most employees, especially in consumer industries, are buyers of competing products. In other industries employees spend time thinking about the competition as part of their jobs, hear about the competition as part of customer support, and generally have a useful perspective on how competing

products will be received in the marketplace. Generally this knowledge is never tapped and should be as part of any competitive strategy.

Example Questions	Participants	Value
• How much market share will X competitor gain with new offering Y? • What will quarterly earnings of competitor X be? • What will the volume sales be of competitor X's product? • What new areas will competitor X enter in to in the next 12 months? • Will competitor X merge with competitor Y?	Company-wide	• React proactively to competitor moves • Re-allocate resources based on need to counter competitor moves • Easily involve field offices who are competitive at the local level • Control the public dialogue • Augment existing risk models and consulting advice

d. Project Planning

On large projects, milestones are typically a moving target. There is also pressure on project managers to complete tasks within a certain period of time at a certain budget. Sometimes for political reasons these milestones are unrealistic, yet because of the business climate they are not changed. Prediction markets can be a credible way to expose reality without getting anyone in trouble.

Example Questions	Participants	Value
• When will milestone X be completed? • Will the resources needed to begin milestone Y be in place by Z date? • Will the prototype of product/service be available for team X's use by Z date?	Product development teams, marketing, suppliers, contractors, outsourced relationships	• Minimize risk of damaging the brand externally and morale internally because of missed milestones • Re-allocate resources based on actual performance and strategic need • Eliminate "spin" caused by organizational hierarchy • Easily involve 3rd parties who own dependencies in the product development process

3. Q&A WITH CLIENTS USING PREDICTION MARKETS

In preparation for this article we asked two of our current clients to respond to questions about their experiences with prediction markets.

a. Cisco

What led Cisco to consider using prediction markets?

There were two main reasons. One was to gain greater insight into what employees were thinking about certain business topics as well as create a collaborative environment for them to do so. The notion of a "weighted vote" on a topic made it even more enticing.

What have been the major challenges of adoption thus far?

Education is the biggest issue. How do the markets work and what is the incentive for them personally.

What has been the biggest lesson learned thus far?

You have to keep up the marketing, communications and evangelism to gain mindshare. The employees have a lot on their plate and you need to make sure they understand the importance and value of prediction markets.

What value have you seen from running the markets, either quantitative or qualitative?

When you get a group perspective on the outcome of an event, it gives the business a sense of what is likely and as a result, what the business strategy might be. We think Cisco is at the tip of the iceberg when it comes to Prediction Markets, but there is a ton of momentum.

b. Global Consumer Products Company

What led you to consider using prediction markets?

We got the idea when reading about the Iowa election market and at the same time dabbling on the Motley Fool stock advisor's CAPS.COM. It was like a lightbulb going on and we knew we wanted to do this for us as an organization. We then read up on the topic and identified 2 potential partners, one of them Inkling, whom we ultimately chose to work with.

What have been the major challenges of adoption thus far?

First, and most importantly, overcoming management resistance and inertia. This took us a good year to get started. Finding the right sponsors, and also the right language to sell the benefits to upper management was key. We are convinced that with my new set of vocabulary and the right analogies, we have won over at least half of the toughest resistors from our first year of struggle. Implementation relative to getting permission to start was very easy. The second challenge now is learning how to ask questions so that the market predictions are actually valuable to the decision makers.

What has been the biggest lesson learned thus far?

Once you find the right language, a large portion of senior managers are excited about the prospects and find it very cool! Especially if you can show them an actual functioning pilot site and can invite them to participate and also use it for getting back in touch with the frontlines.

What value have you seen from running the markets, either quantitative or qualitative?

Quantitative value is still being assessed and its still early to tell. We are convinced though that we will learn not if but how we can quantitatively use the tool. We have already seen a lot of "soft" benefits: People starting to read

up on background information to be able to place good trades. Suddenly we have seen commercial people getting more knowledgeable on our technologies and on what's going on the technical testing front and vice versa. It has also added to the camaraderie on our extended team.

4. LESSONS LEARNED RUNNING A PREDICTION MARKETPLACE

In addition to running our own public marketplace, we have been witness to over 1,000 marketplaces and tens of thousands of questions asked by companies large and small, academics, non-profits, and government entities. Along the way we have collected many lessons learned about what business processes can be positively affected from running prediction markets, how best to launch and maintain a marketplace, incentive strategies for keeping traders interested, and how "accurate" the markets actually are.

c. Time Commitment to Run an Effective Marketplace

Although Inkling provides companies the tools to run an internal marketplace, they do not "run themselves" and a significant investment in time (8-12 hours/week by 1-2 people) is necessary, especially in the first three months of operation to make sure the marketplace is seeded with provocative questions, users receive regular communications about the marketplace, and underlying data is analyzed to provide additional insights.

Beyond the first three months of the marketplace, a more predictable time commitment of 2-4 hours/week has typically been required.

d. How to Launch and Maintain a Marketplace

Companies typically already have practices, policies, and existing communication channels for launching a new online presence whether it's internal or for external customers. Regardless, these are some highlights of the techniques we've witnessed as the most effective in successfully launching a marketplace (in no particular order):

i. Launching a marketplace

- **On the Job Training**: Before rolling out "official" markets, run "play" markets for a few weeks to get everyone acclimated to the marketplace in a low-pressure environment. For example, ask an

entertainment question about a popular television show or ask a question about the company's competition.

- **Heavy Interaction:** Give people plenty of opportunities to ask questions about how the marketplace works. Schedule multiple conference calls or webinars for people to join and do Q&A's. Start an internal blog about the marketplace and interact with users in the discussion threads.

- **Pre-Launch Information Campaign:** While the best way to introduce the concept of a prediction marketplace is to just have people try it, we've seen very effective use of presentations, overview documents, videos, CBT's, etc. as a precursor to inviting people to the marketplace to introduce the concept.

- **Executive Endorsement:** Before spending time in any initiative, employees want to know their time is not being wasted. A brief message by a senior executive stating the results of the markets will be analyzed is all that is usually necessary.

- **The More the Better:** We typically see a 65-75% take-up rate among those who are invited to participate in a corporate marketplace broken down as follows: of those that register, a small percentage of traders will be fanatical users, a large percentage will make a few trades per month, and the remaining may make one or two trades in a multi-month period and otherwise have stagnant accounts. Therefore we always advise organizations to invite as many people as possible (that have some insight in the questions to be asked,) even for a pilot.

ii. Marketplace Management

1. **Start with More than One Market**: Many ask how many markets there should be when the marketplace is launched. There is no research-based answer currently (that we know of) but there are some wrong answers. Having only one market when launching is a bad idea. Traders put all their money in to a single market and prices become extremely volatile. On the other hand, having 20 markets when only 100 people are participating will decrease the liquidity in each market and invalidate many of the predictions. Ideally if a company can get at least 15-20 traders to

participate in any marketing,[1] the results should be valid.

- **Close Markets On Time:** Closing markets on time means closing them *before* the answer is known. If they are closed afterwards, it's no longer a prediction market.

- **Run Markets With Quantitative Answers:** The biggest mistake made by companies trying to run their own markets is asking qualitative questions vs. questions where the results will be known after a period of time.

- **Do not panic:** Often when markets first launch, their prices seem skewed. Many tend to interpret this market action as some sort of manipulation or unfair influence by a few traders. Let the market run its course and do not fall victim to any conventional wisdom that may exist.

e. Incentive Strategies for Keeping Traders Interested

Figuring out the appropriate incentives can be difficult. While one's first inclination is to simply offer prizes, we have not seen this play out as expected. We've assembled an ongoing list of what people have tried or ideas we've had ourselves of how to provide continuing incentives for participation. The most important lessons we've learned is what incentives work are highly dependent on the existing culture of the company and the trading community.

- **Length of Markets:** Ideally the length of time markets are run should be a mix of long-term and short-term, or all short-term. By having some or all markets be short-term, users are more active in the marketplace because they make or lose money more actively. If they are all long-term, they will place their initial trades and may never come back, especially if new information about the questions being asked is few and far between.

- **Loud and Often**: There is nothing better than being right. When the trading community has accurately predicted something, trumpet it as loud as possible. Suddenly the non-believers may start to become believers.

- **Ongoing Communication**: The second best thing to users participating in the marketplace is reading about the marketplace. Marketplace administrators who have set up blogs to discuss the

marketplace on a regular basis have been highly successful at keeping people motivated to participate. A blog creates a natural community around the marketplace for people to discuss interesting insights coming from the trader's predictions. If there is no blogging allowed or the software is not available, consider doing a simple weekly update via email to all the traders in the marketplace. Write it as a newsletter to keep it interesting and readable. Invite others to publish marketplace updates as well either as a community-driven blog or via email.

- **Introducing New Markets:** Because there are potential "first mover" advantages for newly introduced markets, more astute (note: most active) traders will monitor the creation of new markets closely. New markets also incent less active traders to return to the marketplace and participate because there is a greater likelihood they will find something of interest. Finally, adding new markets, like regularly updating the content on a web site, simply makes it more "sticky" and gives the impression the marketplace is active. Encourage users to use an RSS reader to stay on top of new and expiring markets.

- **Interesting Insights:** Use the data created by people trading to discover other insights. Could the data be married with demographic information to create new interesting insights about a group of people? Has someone shown particularly interesting trading patterns? Is there a market where the conventional wisdom says one thing, the market is saying another? Examples such as these should be highlighted as often as possible.

- **Profile/Interview Your Users:** Traders always wonder what makes the #1 person tick. It is their competition, after all. Why do they participate so much? Who are they? People love to learn more about who is behind the pseudonyms and this only encourages further interest in the marketplace.

- **Champions:** Before launching the marketplace, make sure there are "champions" inside and/or outside the organization who are the public face of the effort. Ideally this would be someone very senior or a widely known thought leader whom people typically respect. Have these people comment on the marketplace a couple

times a month by blogging about it or sending out emails to traders.

- **Cash and Prize Incentives:** We do not think cash incentives are necessary to drive participation. However if organizations decide to offer cash incentives or prizes there are some methods we've seen work better than others. Typically the first reaction is to offer a reward to the top trader in a marketplace. But what inevitably happens is the top trader has much more (play) money than many of the other participants and suddenly the incentive is gone for traders 2-x. A better solution we've seen is to create a lottery system to pick a winner from the pool of users where the probability of winning is higher the more play money one has.

- **Competition as Incentive:** There is nothing quite like competition to drive participation and it is simple to take advantage of the natural organizational rivalries that already exist. For example at one of our largest clients, the marketing group has been pitted against the sales team. Every quarter the net worth's of each group are averaged to see who has performed better and the group that wins receives a reward.

- **Exclusive Access as Incentive:** One final idea for providing incentive is to create two separate marketplaces – one for the "general public" or "general employees" and another for those who have performed particularly well over a period of time in individual markets. For example, a company may have 10,000 employees participating in the "general" marketplace. Every 3 months, that company invites 1,000 of those employees to participate in the "exclusive" marketplace. A prediction market is already likely the only place in corporate operations where title means nothing and notoriety is gained by exhibiting forecasting/trading prowess. Reward that performance with exclusivity and punish poor performance or lack of participation by kicking people out who do not perform and replacing them with fresh blood.

- **Run Provocative Markets** – An organization does not have to run markets like "Will the CEO be fired?" but do not be afraid to ask the tough questions as these get people talking and garner great interest.

- **Let Traders Create Their Own Markets** – Letting traders create their own markets can be an excellent incentive to drive participation as market publishers become proxy evangelists for the marketplace since they naturally want to drive participation for their own market.

f. Looking for Market Manipulation

We didn't encounter attempts at active market manipulation until we ran a marketplace for the Chicago Aldermanic elections in 2007. In that marketplace, supporters of candidates began creating multiple accounts and using them to increase prices for their candidates. These accounts are often called "sock puppet" accounts because they are being controlled by a single person. Only after the prediction market began getting attention in the local press did supporters care enough about the perception marketplace prices might bring.

Given the history of Chicago politics, the attempted manipulation should not have surprised us, but monitoring that marketplace, along with other public marketplaces, taught us important lessons about market manipulation when an automated market maker is in use in public marketplaces.

The possibility of manipulation in private marketplaces is through collusion. We will briefly discuss both.

iii. Mistaking Active Trading for "Manipulation" or "Gaming"

Volatile trading patterns are often confused with manipulation of markets. It is therefore prudent to describe typical trading behavior we've seen in markets before addressing the manipulation question.

Let's say an organization creates a market and makes it available for trading. In the beginning of a market, just like during an IPO phase of a new stock, the stocks are volatile. The market is actively capturing people's interest because it's new, people are changing their mind over short periods of time or defending their positions by countering other people's activity with trades of their own, and stocks are moving up and down. *This is a good thing!* It may seem suspicious at first but this is simply people using the markets as they were intended. Over time, the market activity will likely slow as people solidify their positions and reaction to available information has been accounted for, and consensus is reached.

Occasionally we've encountered "hyper-active" trade activity by a few individuals. At first glance it may seem they are trying to "game" the system because they are making many more trades than anyone else. Instead they are

likely doing what any good day trader does: taking advantage of small increases and decreases in market price to make profits in small increments. This behavior is not "ruining" your market or the eventual prediction the market may yield. If the market is actively traded, there will inevitably be others who counteract this behavior. Even if that person amasses a large sum of money and trades one way, the crowd may not agree and can negate this person's effects on the market as long as there is a large and diverse enough body of traders in that market.

iv. One Person, Multiple Accounts

One person driving funds to a single account using other "sock-puppet" accounts is a difficult but not impossible problem to identify and address. This is usually only an issue in public marketplaces where access to multiple email addresses to sign up multiple accounts is trivial.

If a person is manipulating the market to reach a desired outcome with multiple accounts, a sharp rise will be seen in a single account or several people's accounts will continue to lose money over a short period of time as one person's account rises in a single market. Some detective work may be necessary at this point outside of the marketplace. Are the usernames exhibiting this behavior from the same IP address? Do other characteristics about the users seem to follow any patterns? [2]

v. Internal Collusion

Internal collusion is extremely difficult to track unless extensive demographic information about each trader is known. While we are often asked about workers colluding to manipulate prices in a market to their benefit, we've never been notified of it occurring. The best anecdote we know to prevent widespread collusion is ensuring the participants in a marketplace are from diverse backgrounds and are numerous. This way motivational factors for colluding are dispersed across a wide variety of people and no one group will have the ability manipulate others in to trading their way.

vi. Do not Abuse Power

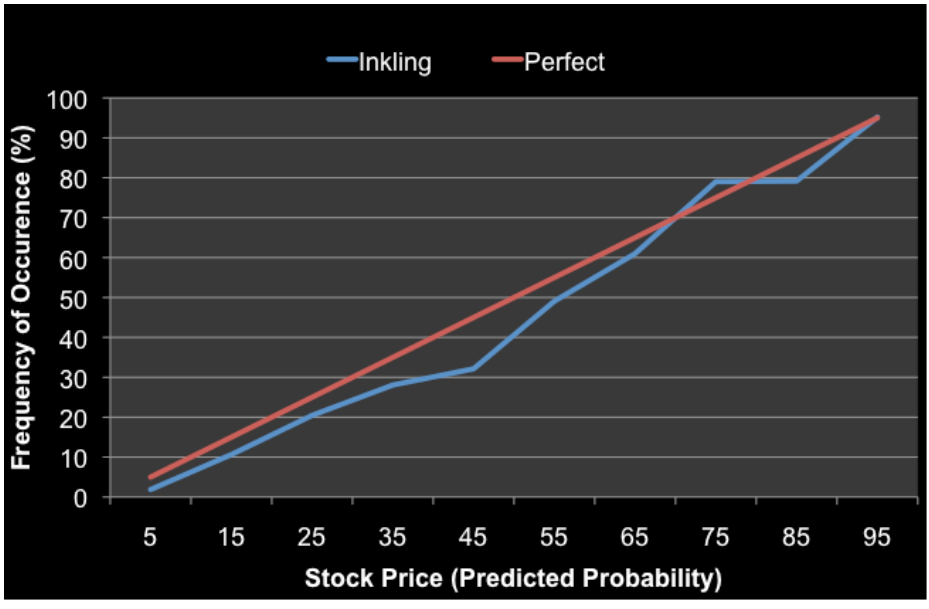
Trading in a prediction market is meant to be anonymous. The marketplace works only if that is *always* the case. The information available, i.e. an individual's trades, should never be shared with others. The insights derived from the data should be generalized. Even when revealing certain information about traders to drive participation as we suggest, an individual's

position in a certain market should never be revealed by anyone other than them. Gaining back the trust of traders is extremely difficult.

a. Marketplace "Accuracy"

One of our biggest challenges in working with our clients has been how to interpret the results of the markets. Because people are used to seeing poll and survey results vs. thinking about prediction market prices as probabilities, an observer may think a prediction market was "accurate" if the highest priced stock was revealed as the correct answer when the market was evaluated. And while it is true that among the possible answers, one inevitably is deemed more probable than the others, if its final price is fairly low, say $38, the traders in that market were saying there was a 4 in 10 chance of that answer being correct – not necessarily a ringing endorsement. [3]

Instead, because evaluating the results of a single market does not reveal much about the accuracy of a marketplace, we took Google's lead[4] and evaluated over 7,000 markets that had been run at the time using the Inkling platform. We wanted to see if indeed stock prices, at the end of the market's lifecycle, reflect probabilities. In other words, if a stock price is $10, was the answer correct 10% of the time?



The graph reveals some interesting things:

- The prices in the prediction markets do closely represent probabilities
- The greatest discrepancy was in the 40-50 range. Because 50% is essentially a "tossup," the markets may also be interpreting the answer as a "tossup."
- The prediction market is serving as an effective filter to discriminate between answers that are highly likely and those that are not
- We were not able to detect any long-shot bias from this data as this does not account for the size of trades made.

b. Should Your Company Start a Prediction Marketplace?

Because we offer a free pilot of our platform, we've been witness to companies who work through the pilot and continue towards rolling out to large portions of their company and we've also been witness to efforts that never make it beyond the pilot stage. We've hypothesized that pilots fail for three primary reasons:

- *Scared senior management:* Although one could argue companies with insular and politically driven cultures need prediction markets the most, they are also the most difficult to introduce them to. Employees with decision-making authority that could introduce a cross-department capability like prediction markets are often too nervous to reveal information that may make them look bad and kill pilots before they have a chance to prove their value.

- *Confusion about appropriate questions to ask in marketplace:* Buzz about prediction markets in the popular press has been helpful in pushing organizations and individuals to experiment. However many still interpret their use as another polling or prioritization mechanism. We often see questions that have no verifiable outcome, i.e. "Should we invest in x technology?" or questions that have little or no value to the organization.

- *The numbers just aren't there:* Even for a "pilot" enough traders must play to provide the diversity and participate rate necessary to provide an appropriate level of input. We are often contacted by companies who want to run a pilot among five to seven "friends." This is certainly enough people to evaluate our platform but not enough to begin evaluating prediction market outcomes as reliable probability indicators.

In contrast, we've learned pilots tend to succeed for some of the following reasons:

- *Strong support among senior management:* Prediction markets are no different than any other strategic initiative in a company. If senior management is supportive or if the sponsor of a prediction market is part of senior management at a company, the marketplace has a much higher probability of being utilized.

- *Thought leader dedicates him/herself to effort:* Senior management's sponsored efforts often succeed because of their title. Thought leader's efforts often succeed because of the respect they garner. Whether they are at a low or high level in an organizational structure, thought leaders in companies regularly think of provocative questions to ask, draw valuable insights from the raw data the marketplace generates, and works above the limitations set forth by a stove-piped organization to get others involved.

- *Provocative/meaningful questions are asked early and often:* Being enamored with a group of people in a company predicting any future event is not a recipe for long term success. Before asking any questions in a marketplace, a successful administrator should ask: "what business value will knowing the probability of an outcome bring?"

- *Results/insights from the prediction market become part of the corporate dialogue:* When employees are using probability data from the prediction market in status reports and water-cooler conversations, the prediction marketplace has reached a level of credibility that usually foreshadows long-term and valuable usage.

5. CONCLUSION

After working for companies across many industries and for clients at many levels from C-Level on down, we saw the need for an application that on its surface improves certain business processes but also addresses shortcomings in corporate culture by making information and knowledge more transparent and driving towards a more "reality-based" environment.

While one could argue prediction markets are applicable to any company large or small, for-profit or not-for-profit, their success hinges on several

factors. They are not a tool one can simply unleash in an organization and value is automatically realized. Communications before the launch of a marketplace and throughout its tenure must be informative and frequent, appropriate incentive structures (and not just ones that involve prizes) must be in place, and questions must be formulated in a certain way to not only ensure the answer can be evaluated but the output from the market is providing business value.

6. APPENDIX: TIPS FOR GETTING STARTED WITH A PREDICTION MARKETPLACE IN YOUR ORGANIZATION

Many organizations large and small are hearing about the benefits other organizations are experiencing implementing internal prediction markets. Here are some tips on how to get started:

1. Identify questions to be asked in a pilot marketplace and how answers to those questions will be determined.

2. Understand how those forecasts and risks are being calculated currently, if at all, in order to later understand quantitative ROI of the marketplace.

3. Identify internal "champions" who will support the pilot. These leaders must:
4.
    a. Be supporters of the concept and regularly encourage their people to participate
    b. Discuss the ongoing activity in the marketplace during meetings and briefings

5. Identify a broad range of "traders" to participate according to the markets being run. All levels and relevant disciplines should be asked to participate. The more, the better, but a crowd can be "dumb" too. Make sure participants have *some* perspective about a majority of the questions being asked.

6. Setup marketplace with questions and invited users.

7. Determine formal or soft incentives as discussed previously.

8. Define launch strategy and prepare necessary materials. Internal communications shops are excellent resources to help with the launch.

    a. Training video/presentation
    b. Communications

9. Setup internally accessible blog or discussion board for participants to discuss marketplace, provide feedback and suggest new ideas for markets.

10. Launch!

11. Highlight participation, accurate forecasts, and interesting insights from marketplace data as soon and loudly as possible.

7. ABOUT INKLING

Inkling Incorporated is a Chicago-based company that helps organizations and individuals tap into the collective wisdom of their employees, peers, and customers to improve forecasting processes, predict key corporate metrics, identify promising future innovations, and forge new communication and collaboration channels. Inkling's prediction market platform, Inkling Markets, is leveraged by numerous corporations, start-ups, academic, non-profit, and Government institutions. Information about Inkling's services can be found at http://inklingmarkets.com and private, secure pilot marketplaces can be created at http://inklingmarkets.com/trial.

NOTES

1. Jed Christiansen "Prediction Markets: Practical Experiments in Small Markets and Behaviours Observed" The Journal of Prediction Markets 2007 1, 17-41.
2. Since running the Aldermanic markets, we've developed many monitoring tools for marketplace administrators to look for patterns of collusion.
3. We have not formally researched why in some markets there is sometimes a clear leader with a high probability vs. a leader at a lower probability. We can hypothesize however that this is either due to a lack of participation in the market, not enough information available to traders, or a conflict among participants about the prediction.
4. http://googleblog.blogspot.com/2005/09/putting-crowd-wisdom-to-work.html

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"THE EMERGENCE OF PREDICTION MARKETS WITHIN BUSINESS FIRMS: A SKEPTICAL PERSPECTIVE FROM AN INTRIGUED ACADEMIC."

Paul W. Rhode[*]

Learning about the recent emergence of prediction markets within business firms has been fascinating and a bit confusing. As an economist who works on historical political stock markets, I believe this intriguing endeavor will be a road worth traveling but one littered with potholes and rocks at unexpected places. Perhaps my sense that employing prediction markets within firms will be a jarring experience comes from the impression formed by my first exposure to the idea: where higher-ups at Microsoft created a small-stakes market for the programming team designing internal-company software about whether their project manager's deadline would be met. I could readily see why the higher-ups wanted this insider information, but creating such a market seemed entirely at odds with employing hierarchal authority (bosses) or scheduling plans (artificial deadlines) in the first place. Perhaps this sense that prediction markets and business firms do not naturally coexist comes from my professional training.

As an economist, I am taught to think about the operation of markets and the ways of the Invisible Hand. I am less equipped to understand firms and the authority relations associated with the Visible Hand. D. H. Robertson famously said firms were "islands of conscious power in this ocean of unconscious co-operation like lumps of butter coagulating in a pail of buttermilk."[1] Ronald Coase won the 1991 Nobel Economics Prize in part for his early work on the theory of the firm.[2] Economics is just coming to grips with the existence of firms, operating within markets. Imagine the challenge of trying to understand the emergence of prediction markets within firms.

There would seem to be an inherent tension between markets and organizations such as business firms with hierarchal authority. Of course, firms have long often had internal markets and market-like allocation systems. In vertically integrated firms, outside supply prices influence the "shadow" prices used in the "make-or-buy" decision. The external cost of capital helps

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[1] Dennis H. Robertson, *The Control of Industry* (New York: Harcourt-Brace, 1923), p. 85.

[2] Ronald H. Coase, "The Nature of the Firm," *Economica*, 4 ns (1937), pp. 386-405.

solve the capital-allocation problem for internal investment projects. And large firms have long utilized internal labor markets, with job promotion occurring within the hierarchy. So the idea of adding internal information markets is not completely novel or out-of-left-field.

In many ways, tapping of the wisdom of crowds within the firm is intended to overcome the information barriers created by the bureaucracy. It is obvious that the upper management might want better access to selected information available down the organizational ladder, to stop having to listen to the self-serving lies of middle management. But it seems to me, the individuals in an organization derive their power from the information under their exclusive control and will not easily give up this monopoly position. What models we economists have about hierarchies largely concern controlling information flows, both up and down the organization. This includes both having the higher-ups monopolize the firms' secrets and strategies and preventing them from being overwhelmed by the day-to-day minutia.

With internal prediction markets, key questions include who will set the agenda, who decides what questions will be answered and how? It seems authority matters in whether this is done in a top-down or bottom-up manner. If the question is what is the best forecast for demand growth, will this deadline be met, or how will the product rank in quality tests, it is clear that upper management, the "deciders," would be happy to learn from the collective wisdom of employees in contact with customers or doing the design work. If the questions posed address how long before the company president is fired, whether this product is found defective and has to be recalled, or when the mass layoffs will begin, then upper management will be unhappy.

Prediction markets provide more information, but they do so in a public way. What prevents competitors from spying, from gaining access to company secrets? Besides making private information common knowledge, prediction markets undermined the mystique, the information monopoly of those in charge. It is an old idea, but remains powerful: markets tend to dissolve traditional relationships of authority. The notion that the wisdom of the crowd is smarter than the smartest person in the room, or the most senior, or most highly-paid may not sit so well with that person. The only way for that person to "win" would be to beat the market. Where will this lead? to better decisions? to riskier behavior? (Business Mag Profile of a Dumb-Luck Winner: everyone thought X but this business hero proved his superiority by doing Y)? to more second guessing? to more shareholder lawsuits? Only experience will tell. Using prediction markets within firms is a road worth traveling but the ride is likely to be rough.

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PRIVATE PREDICTION MARKETS AND THE LAW

Tom W. Bell[1]

ABSTRACT

This paper analyses the legality of private prediction markets under U.S. law, describing both the legal risks they raise and how to manage those risks. As the label "private" suggests, such markets offer trading not to the public but rather only to members of a particular firm. The use of private prediction markets has grown in recent years because they can efficiently collect and quantify information that firms find useful in making management decisions. Along with that considerable benefit, however, comes a worrisome cost: the risk that running a private prediction market might violate U.S. state or federal laws. The ends and means of private prediction markets differ materially from those of futures, securities, or gambling markets. Laws written for those latter three institutions nonetheless threaten to limit or even outlaw private prediction markets. As the paper details, however, careful legal engineering can protect private prediction markets from violating U.S. laws or suffering crushing regulatory burdens. The paper concludes with a prediction about the likely form of potential CFTC regulations and a long-term strategy for ensuring the success of private prediction markets under U.S. law.

INTRODUCTION

This paper analyses the legality of private prediction markets under U.S. law, describing both the risks they pose and some potential cures. The use here of "private" (or, equivalently, "in-house") refers to markets open not to the public but rather only to members of a particular firm.[2] The Foresight

[1] Professor, Chapman University School of Law. I thank Koleman Strumpf for encouraging my work on this topic, and participants at two events—the Conference on Corporate Applications of Prediction/Information Markets, held at the Kauffman Foundation Conference Center in Kansas City, Missouri, November 1, 2007, and the Collective Intelligence Foo Camp, held at the Googleplex in Mountain View, California, February 22-23, 2008—who commented on presentations of some of the ideas expressed here. I take sole responsibility for this paper as submitted for publication, however.

[2] More specifically, by "members" I intend to include both common law employees of a firm

Exchange[3] and the Iowa Electronic Markets,[4] because they generally welcome anyone to join in the trading they host, represent examples of *public* prediction markets. *Private* prediction markets, such as those run by Google, Best Buy, and a growing number of companies,[5] support trading only by each firm's members and only in support of a common business enterprise. In private prediction markets, traders do not trade solely for the sake of trading; they do so in the course of their employment.

A growing number of firms have in recent years begun running in-house prediction markets, using them to collect and quantify data useful for firm management. The actions of those firms say more about the benefits of prediction markets than my words ever could, so I will not belabor the point. Instead, I here focus on a cost: the risk that private prediction markets—especially those that offer real-money prizes[6]—might violate U.S. state or federal laws. I adopt this critical point of view not to condemn such markets, but rather to protect them. Only after a clear-eyed study of the legal risks threatening private prediction market can we formulate workable defenses.

Part I sketches the ends and means of prediction markets, demonstrating that they differ significantly from the ends and means of futures, securities, and gambling markets. The laws written for those sorts of markets thus do not fit prediction markets very well. Still worse do they suit *private* prediction markets. Part II explains why those laws nonetheless threaten private prediction markets. As Part II explains, however, prudent legal engineering can protect private prediction markets from violating the law or suffering crushing regulatory burdens. Part III describes the bright future of private prediction markets, the likely impact of potential regulations by the CFTC, and a strategy designed to ensure that all prediction markets—private and public, alike—might thrive and grow under U.S. law.

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and independent contractors who, because their access to confidential information of the firm burdens them with fiduciary obligations, qualify as common law agents of the firm. *See* Restatement (Second) of Agency (2d) § 2(3) (1958) (defining "independent contractor" as "a person who contracts with another to do something . . . . He may or may not be an agent.").

[3] *See* http://www.ideosphere.com/ (visited May 7, 2008).

[4] *See* http://www.biz.uiowa.edu/iem/ (visited May 7, 2008).

[5] *See* Steve Lohr, "Betting to Improve the Odds," *N.Y. Times*, April 9, 2008, at http://www.nytimes.com/2008/04/09/technology/techspecial/09predict.html?ei=5070&en=135eefaa8873036b&ex=1208404800&emc=eta1&pagewanted=print.

[6] Whatever their virtues, in-house prediction markets that offer only play-money payoffs do not raise face dire legal threats. I thus for the most part do not address them. It bears noting, however, that the threats that illegal insider trading laws pose to real-money private prediction markets pose an equal threat to play-money private markets.

PART I: THE UNIQUE STATUS OF PRIVATE PREDICTION MARKETS UNDER U.S. LAW

The ends and means of prediction markets differ materially from the ends and means of futures, securities, and gambling markets. The policy reasons for regulating those sorts of markets thus do not fit prediction markets very well. Private prediction markets, in particular, have ends and means different from those of other, more conventional and heavily regulated markets. Rather than offering thousands of words explaining that claim, I here offer two illustrations of it, in figures 1 and 2, below.[7]

Purpose: / Type:	Express Prices	Promote Discovery	Entertain	Hedge Risks	Raise Capital
Prediction Market	primary	secondary	tertiary	tertiary?	N.A.
Futures Market	secondary[8]	tertiary?	N.A.	primary[9]	N.A.
Securities Market	secondary	tertiary?	N.A.	tertiary[10]	primary[11]
Gambling Market	N.A.	N.A.	primary	N.A.	N.A.[12]

[7] For the details behind these policy portraits, see Tom W. Bell, "Prediction Markets for Promoting the Progress of Science and the Useful Arts," 14 *Geo. Mason L. Rev.* 37 (2006). This part's discussion of the tables derives in part from the discussion in that earlier paper.

[8] *See* Commodities Futures Trading Commission [hereinafter, "CFTC"], *The Economic Purpose of Futures Markets and How They Work*, http://www.cftc.gov/educationcenter/economicpurpose.html (last visited Oct. 29, 2008) (saying, "[P]rice discovery [] is considered an important economic purpose of futures markets.").

[9] CFTC, *supra* note [[cite]] ("Futures markets are . . . designed as vehicles for hedging and risk management . . . .").

[10] Investing in securities may help an investor hedge against loss by dint simply of diversifying her portfolio.

[11] *See* U.S. Securities and Exchange Commission, *The Investor's Advocate: How the SEC Protects Investors, Maintains Market Integrity, and Facilitates Capital Formation*, http://www.sec.gov/about/whatwedo.shtml (last visited Feb. 27, 2006) ("The mission of the U.S. Securities and Exchange Commission is to protect investors, maintain fair, orderly, and efficient markets, and facilitate capital formation.").

[12] States sometimes justify their lotteries as a means for funding for education or other worthy ends. *See, e.g.*, California State Lottery, *Supporting Education*,

Figure 1: Market Type v. Market End

Figure 1 illustrates that prediction markets exhibit a unique concern for expressing prices and promoting discovery. The goals most important to other markets—hedging risks, raising capital, and entertainment—matter comparatively little to prediction markets as a class. The sort of prediction markets of particular interest here—those that limit trading to the agents of a common enterprise and about questions relevant to the enterprise's success—differ still more sharply from futures, securities, or gambling markets.

Prediction markets aim primarily to aggregate and reveal prices—positive externalities that offer accurate, timely, and quantified answers to important questions. Private prediction markets, in particular, aim at encouraging the discovery of truths about questions concerning some common enterprise, such as the likely shipping date of a new product or the effect of an ad campaign on sales. As a consequent and secondary matter, prediction markets can stimulate research by rewarding it.

Prediction markets do not typically aim solely or primarily at entertainment, though they might offer it. In particular, the sorts of claims generally traded on private prediction markets—claims about such dry but important questions as a supplier's reliability—do not look likely to offer much intrinsic entertainment value.[13] Private prediction markets in skill-based claims thus ought to escape the reach of gambling regulations. Still less would private prediction markets support the sort of hedging functions that justify the CFTC's regulation of futures markets.[14]

Prediction markets use means different from those of conventional markets. Table 2 summarizes the distinctions. It illustrates that prediction markets alone offer skill-based spot trading of conditional claims (rather than of underlying assets), usually on a zero-sum basis, and without exposing traders to losses greater than their investments. That collection of features distinguishes all types of prediction markets, pubic and private alike, from futures, securities, and gambling markets. The next Part details why those

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http://www.calottery.com/Support/LotteryFunds/ (last visited Feb. 27, 2006),
That does not mean lotteries "raise capital" for investment, however; it means simply that that lotteries substitute for tax revenues.

[13] *See* Robin Hanson, "Could Gambling Save Science? Encouraging an Honest Consensus," *Soc. Epistemology*, Jan. 1995, at 3,16 *available at* http://hanson.gmu.edu/gamble.html ("[S]cience questions are generally too long term to be a problem [for compulsive gamblers], offering no more 'action' than long-term stock investments.").

[14] Granted, a thoughtful and risk-averse employee might perhaps use a private market to hedge against loss, such as by investing in claims that his company will not pay a year-end bonus. That seems unlikely to constitute a major function of a private prediction market or to account for more than a *de minimus* amount of trading.

differences give private prediction markets a fair claim to escaping the reach of the CFTC, SEC, and state-level gambling laws.

Feature: / Type:	Skill-based Trading	Spot Trading	Zero-Sum Trading	Under-lying Assets	Risk of Loss Greater than Invest-ment
Prediction Market	yes	yes	usually	no	no
Futures Market	yes	no	yes	usually	yes
Securities Market	yes	usually	no	usually	some-times
Gambling Market	no	yes	yes	no	some-times

Figure 2: Market Type v. Market Means

PART II: LEGAL THREATS TO PRIVATE PREDICTION MARKETS AND SOME RESPONSES

As the prior Part explained, U.S. laws pertaining to futures, securities, or gambling markets do not fit private prediction markets very well. As this Part explains, however, those laws nonetheless pose some risk of clumsily regulating, or even outlawing, private prediction markets. To avoid that unwelcome result calls for more than abstract policy arguments; it calls for careful legal engineering. In brief, private prediction markets can reduce their exposure to legal liability if they:[15]

[15] Note that you will not find among these suggested strategies, "Run the private market overseas." That would not protect a firm from liability under U.S. law if any acts illegal under that law occurred on U.S. soil, such as would happen if a resident employee illegally traded on insider information obtained from her firm's overseas-based prediction market. A firm U.S. firm could avoid that sort of liability by moving all of its assets and personnel out of the U.S., of course, but that seems a rather drastic measure.

- Avoid supporting hedging functions;
- Offer only spot exchanges of conditional negotiable notes;
- Publicize material information or safeguard against insider trading; and
- Require agents of the firm to trade on the market.

Those strategies err on the side of caution, admittedly, and might seem rather defensive to the sort of risk-loving, cutting-edge companies most likely to use prediction markets. Perhaps that explains the relative dearth of such legal prophylactics. More likely, though, most firms running private prediction markets have yet to carefully assess, much less mitigate, their legal risks. This Part offers a clear-eyed view of the legal terrain and describes a safe path for the advance of private prediction markets.

A. PRIVATE PREDICTION MARKETS AS FUTURES MARKETS

A real-money *public* prediction market operating with the reach of U.S. law would run some risk of falling prey to regulation by the Commodities Futures Trading Commission ("CFTC").[16] A *private* prediction market would probably run a smaller, but not zero, risk of the same result. This section briefly describes the scope of that threat and offers some curative responses. It bears noting up front, however, that considerable uncertainty surrounds this question—so much so that the CFTC itself recently issued a request for comments about whether and to what extent it should have any say over how prediction markets operate.[17]

As the CFTC has observed, prediction markets often offer binary option contracts akin to those over which the Commission has claimed exclusive jurisdiction.[18] Any public prediction market that offered real-money trading on such contracts, and that does so within the reach of U.S. law, would thus arguably fall within the CFTC's regulatory purview—especially if the market offered significant hedging functions. Notably, however, a prediction market

[16] For a more complete discussions of that question, see Bell, *supra* note [[cite to GMU paper]] at 67-68; Bell, *supra* note [[cite to Chapman article]] at 170-72.

[17] *See* "Concept Release on the Appropriate Regulatory Treatment of Event Contracts," 73 *Fed. Reg.* 25,669 (2008) at http://www.cftc.gov/lawandregulation/federalregister/proposedrules/2008/e8-9981.html (visited May 18, 2008).

[18] *See id.* at 25670. Conceivably, a prediction market could offer contracts structured to resemble the sorts of futures contracts also subject to the exclusive jurisdiction of the CFTC. *See id.* at 25670-71.

could probably dodge that outcome by carefully choosing the sorts of instruments in which it deals. Even though they facially resemble the sorts of instruments traditionally regulated by the CFTC, for instance, lottery tickets and foreign currency "forex" contracts fall outside of the CFTC's jurisdiction.[19] To likewise escape the Commission's reach, prediction markets should deal only in spot (rather than future) exchanges of conditional negotiable notes (rather than contracts).[20]

Private prediction markets, in particular, have good claim to falling outside the CFTC's regulatory authority. First, it looks unlikely that most private prediction markets would routinely offer the sort of significant hedging functions that characterize markets falling within the CFTC's jurisdiction. That level of hedging requires quite thick markets, whereas few private markets would attract sufficient trading to offset large monetary losses. Nonetheless, as a safeguard against venturing into the CFTC's jurisdiction, a private prediction market might wisely choose to bar trading above certain levels of capitalization, revenue, or volume.[21] That would assure that the market does not support significant financial hedging, yet leave it free to pursue its primary purpose: discovering what an enterprise's agents think about its future.[22]

Private prediction markets can also cite their closed nature as a second reason why they have a particularly good claim to escape the CFTC's jurisdiction. A great many of the markets that the CFTC regulates, such as the HedgeStreet Exchange, operate as retail establishments, with their doors open to almost any member of the public.[23] The CFTC also regulates markets open

[19] *See Commodity Futures Trading Comm'n v. Zelener*, 373 F.3d 861, 867 (7th Cir. 2004) (affirming that exchange of present payment for right, conditional on demand, to present delivery of foreign currency qualifies as "spot" rather than "futures" trading, and thus falls outside the CFTC's jurisdiction).

[20] A conditional note takes the form, "If condition X obtains, the holder of this note can redeem it for $1 from the Bank." They qualify as notes, rather than contracts, because they do not win legal efficacy via offer and acceptance. A spot market in conditional notes would support the exchange of such notes for value and for present delivery. Thus, for instance, you might for $60 buy on such a market 100 notes, each paying $1 if your company ships its newest product on schedule. You would take immediate possession of the notes, and look forward to perhaps cashing them in later for $1 each, making a profit (ignoring such costs as lost interest) of $40.

[21] Some commentators have suggested formalizing that approach. *See, e.g.*, Robert W. Hahn & Paul C. Tetlock, "A New Approach for Regulating Information Markets," 29 *J. Reg. Econ.* 265, 277 (2006) (suggesting that the CFTC should exempt from regulation prediction markets that are limited in the size of investment).

[22] A caveat: limiting markets too sharply, or in the wrong way, runs the risk of decreasing their functionality.

[23] *See* Hedgestreet, *Open An Account*, at https://www.hedgestreet.com/open-account/ (visted May 7, 2008) (describing requirements for opening a trading account).

only to participants who satisfy special statutory criteria, granted.[24] Those markets must presumably admit each trader who so qualifies, however; unlike a corporation setting up a private prediction market, they cannot freely pick and choose who can access the market. Because their hosts retain absolute discretion over who trades on them, therefore, private prediction markets differ markedly from the types of markets over which the CFTC claims jurisdiction.

B. PRIVATE PREDICTION MARKETS AND SECURITIES REGULATIONS

Securities regulations threaten private prediction markets on two major fronts. First, the SEC might in theory claim that such markets themselves deal in securities. For reasons discussed in subpart 1, however, that does not look like too worrisome a risk. Second, and more plausibly, a publicly-traded corporation's private prediction market might facilitate illegal insider trading of its host corporation's securities.[25] Subpart 2 describes the scope of that risk and offers several suggestions about how to manage it.

1. Private Prediction Markets as Securities Markets

Would the claims traded on a private prediction market qualify as "securities" under U.S. law?[26] History and public policy say, "Not very likely." The claims traded on a private prediction market look nothing like the sort of financial instruments—fractional ownership in business enterprises—that have traditionally fallen within the jurisdiction of the SEC.[27] Nor do private prediction markets function at all like the sorts of markets the SEC regulates.[28] Most notably, securities markets create wealth by making capital available for productive purposes, whereas prediction markets pit each

[24] *See* CFTC, *Trading Organizations*, at http://www.cftc.gov/industryoversight/tradingorganizations/index.htm (visited May 7, 2008) (outlining the criteria for trading on derivative transaction execution facilities and various "exempt" institutions).

[25] A corporation that is not publicly-traded of course need not worry about illegal insider trading of its shares.

[26] For a more complete exploration of this question, see Bell, *supra* note [[cite to GMU article]] at 77-82.

[27] *See Chicago Mercantile Exch. v. Sec. & Exch. Comm'n*, 883 F.2d 537, 543 (7th Cir. 1989) ("A security, roughly speaking, is an undivided interest in a common venture the value of which is subject to uncertainty.").

[28] *See supra*, figures 1 & 2.

trader against all others in a zero-sum game.[29] The statutes that define the SEC's jurisdiction leave room for debate, granted.[30] By and large, though, courts have interpreted those statutes to give the SEC authority only over financial instruments similar to those traditionally regulated by the Commission.[31] The sorts of claims traded on a private prediction market look unlikely to qualify on that count.

2. Insider Trading Regulations

Broadly speaking, U.S. law forbids two types of insider trading. The traditional or "classical" theory of illegal insider trading bars a corporate insider from trading the securities of his or her corporation "on the basis of material, nonpublic information."[32] The "misappropriation" theory of illegal insider trading, in contrast, bars a corporate "outsider" from trading a corporation's securities in breach of an obligation to maintain the confidentiality of material information about the corporation.[33] Private prediction markets run the risk of facilitating both sorts of insider trading.[34] These risks differ only in kind—not in principle—from extant ones. This

[29] *See* Thomas Lee Hazen, "Rational Investments, Speculation, or Gambling? Derivative Securities and Financial Futures and Their Effect on the Underlying Capital Markets," 86 *Nw. U. L. Rev.* 987, 1002 (1992) at p 1006-07.

[30] *See* David J. Gilberg, "Regulation of New Financial Instruments under the Federal Securities and Commodities Laws," 39 *Vand. L. Rev.* 1599 (1986) at p 1622 ("[T]he securities Act definition of a security] has been the subject of extensive judicial and legal debate and has spawned probably the most extensive literature in the areas of securities and commodities regulation.") (footnote omitted).

[31] *See, e.g., Reves v. Ernst & Young*, 494 U.S. 56, 64-65 (1990) (adopting a "family resemblance" test for determining whether a note qualifies as a security governed by the 1934 Act); *Landreth Timber Co. v. Landreth*, 471 U.S. 681, 687 (1985) (adopting a definition of "stock" that would fit it within the definition of "security" because "an investor [buying that stock] would believe he was covered by the federal securities laws").

[32] *United States v. O'Hagan*, 521 U.S. 642, 652 (1997). The definition of "corporate insider" here includes "not only officers, directors, and other permanent insiders of a corporation, but also to attorneys, accountants, consultants, and others who temporarily become fiduciaries of a corporation." *Id.*

[33] *Id.*

[34] Though my conversations with those who offer prediction market services to corporations, and those who buy those services, suggests that this issue concerns them a great deal, I've not yet found any published papers on the topic. Other aspects of the interplay of prediction markets and insider trading have drawn academics attention, granted. *See, e.g.*, Robin Hanson, "Insider Trading and Prediction Markets," 4:2 *Journal of Law, Economics, and Policy*__ (2008) (forthcoming), available at http://hanson.gmu.edu/insiderbet.pdf. That still leaves unanswered, however, the question of how private prediction markets might create risks under illegal insider trading laws and what to do about it.

section diagnoses the legal ill, prescribes a good dose of the usual remedies, and offers a somewhat experimental supplementary therapy.

a) Liability for Illegal Insider Trading. Suppose that a corporate insider, such as a CEO, used material information gleaned from a non-public, in-house prediction market to time the purchase or sale of the corporation's securities. That would probably qualify as illegal insider trading under the classical theory.[35] As fiduciaries of their corporations' shareholders, insiders bear special obligations to not trade on material, nonpublic information about their corporations.[36]

Non-insiders, such as run-of-the-mill employees or independent contractors of the corporation, generally bear no corresponding duty.[37] Even they, however, can become "remote temporary insiders" by dint of entering into a special confidential relationship with the corporation.[38] Suppose, then, that a low-level employee of the corporation acquired material information from her corporation's private prediction market and then used that information to trade the corporation's securities. Her access to that non-public material information might qualify her as a remote temporary insider, thereby rendering her just as liable, under the classical theory of illegal insider trading, as the company's CEO.

Misappropriation theory offers another route to liability for illegal insider trading. Under this alternative to the classical theory, a low-level corporate employee or (more likely) independent contractor might commit insider trading by trading on information gleaned from the firm's private prediction market.[39] The theory gets its name from the notion that the illegal insider

[35] The same analysis would apply if the CEO instead advised his niece to trade the corporation's securities based on that material, non-public information, thereby violating his fiduciary duty to the corporation, and the niece did so knowing of that breach. Even a "tippee" who is not a corporate insider might thus be held liable for illegal insider trading. *See Dirks v. SEC*, 463 U.S. 646, 659 (1983) ("[T]he tippee's duty to disclose or abstain is derivative from that of the insider's duty.").

[36] *See Chiarella v. United States*, 445 U.S. 222, 230 (1980) ("Application of a duty to disclose prior to trading guarantees that corporate insiders, who have an obligation to place the shareholder's welfare before their own, will not benefit personally through fraudulent use of material, non-public information.").

[37] *Id*. at 231-35.

[38] *Dirks v. SEC*, 463 U.S. 646, 655 n.14 (1983) ("Under certain circumstances . . . outsiders may become fiduciaries of the shareholders. The basis for recognizing this fiduciary duty is not simply that such persons acquired nonpublic corporate information, but rather that they have entered into a special confidential relationship in the conduct of the business of the enterprise and are given access to information solely for corporate purposes.").

[39] *See United States v. O'Hagan*, 521 U.S. at 652 ("In lieu of premising liability on a fiduciary relationship between company insider and purchaser or seller of the company's stock, the

trader has, in that event, misappropriated valuable confidential information from the corporation.

No matter how a private prediction market leads to illegal insider trading, civil or criminal sanctions might follow. It does not look very likely that merely *hosting* a private prediction market would suffice to render a corporation *itself* liable for illegal insider trading. At the least, a complaint would have to establish that the corporation's prediction market had abetted or recklessly failed to prevent illegal insider trading.[40] Even if they do not threaten the corporation directly, however, the pall cast by illegal insider trading laws could understandably discourage a corporation from running a private prediction market. Even apart from a well-founded concern for its insiders, no corporation would welcome the heavy evidentiary burdens imposed by investigations into illegal trading of its shares.

b) Legal Cures. How can publicly-traded corporations run private prediction markets and yet dodge illegal insider trading laws? For a simple and sure-fire fix, a corporation could make public the claims traded on its private prediction market and their prices. Illegal insider trading relies on *non-public* material information, after all; making the information public dissipates liability. But many corporations would refuse to make that sort of information public, regarding the prices of claims on its in-house prediction market, or even the claims themselves, as sensitive information. A corporation might host a private prediction market in order to generate new trade secrets, which have value—indeed, that *exist*—only insofar as they remain confidential.

A corporation might thus prefer an alternative safeguard against illegal insider trading laws: bifurcated private markets, one available solely to officers and other insiders and another solely for other agents of the corporation to trade on.[41] That bifurcated structure would help to ensure that

misappropriation theory premises liability on a fiduciary-turned-trader's deception of those who entrusted him with access to confidential information.").

[40] Although the theories under which a firm might be held liable for the illegal insider trading of its agents vary, they basically boil down to knowingly or recklessly inducing or failing to prevent the wrong. *See* Harold K. Gordon and Tracy V. Schaffer, "Recent SEC Actions Show Employer Liability for Insider Trading," *Law.com*, July 30, 2007, at http://www.law.com/jsp/ihc/PubArticleIHC.jsp?id=1185527216922 (visited April 25, 2008) (describing various ways in which a firm might be held liable for the illegal insider trading of its employees). Careful firms should thus not find it too difficult to implement procedures sufficient to avoid a lawsuit brought by the SEC on that count. As to private parties, thanks to the holding of *Central Bank of Denver, N.A. v. First Interstate Bank of Denver*, N.A., 511 U.S. 164 (1994), they have no standing to sue a corporation for aiding and abetting illegal insider trading.

[41] At least one major corporation (which I will not name here) has implemented such a segregated market structure, albeit not evidently in order to dodge illegal insider trading laws.

inside information generated by the private prediction market remained within the corporation's executive suites, where it would easily fit within the same sort of controls—blind trusts or trading windows, for instance—that apply to inside information generally. That would protect both a corporation's insiders and, since they might otherwise qualify as "tippees" liable under the same theory, non-insiders from liability under the classic theory of illegal insider trading.

Even a market that keeps insider trading separate from non-insider trading raises some risk of illegal insider trading, however. A private prediction market, even if restricted to traditional non-insiders, generates material information about its host corporation. So long as it is not made public, but rather offered only subject to confidentiality obligations, that information can turn otherwise outsiders into remote temporary insiders. Furthermore, because the claims and prices of a private prediction market would quite likely constitute trade secrets,[42] even a non-insider employee who buys or sells shares of the host corporation based on information gleaned from its private market might, under the misappropriation theory, violate illegal insider trading laws.

Broadening participation in a private prediction markets thus broadens the risk of illegal insider trading. A corporation might run that risk for good reason, granted; prediction markets offer a very useful tool for gathering and quantifying information distributed throughout an organization. A corporation would still want to mitigate its exposure to legal risks, however. How to do so? In brief, I suggest four strategies:

- Segregating markets for traditional insiders from other markets.
- Broadening safeguards against illegal insider trading to reach beyond traditional insiders.
- Treating the market's claims and prices as trade secrets.
- Setting up decoy claims and prices.

Allow me to expand on those four strategies, in order. First, as mentioned above, a corporation should consider running segregated markets. That can help to forestall claims that traditional insider info has leaked out of the corporate headquarters. Second, as a corporation broadens access to its private markets, it should also broaden the sort of legal safeguards traditionally reserved for dealings with corporate insiders. The corporation should thus admonish all who participate in its private markets against trading on the information thereby disclosed. Click-through interfaces could make

[42] *See* Uniform Trade Secret Act § 1(4) (defining "trade secret").

those admonitions routine and unavoidable. Third, the corporation should inform all who access its private prediction market that claims and prices constitute the corporation's trade secrets. That helps to ensure that the corporation, far from being considered jointly liable for any insider information, will instead have a misappropriation claim against anyone who trades the corporation's shares based on information gleaned from the corporation's private prediction market. That sort of notice could, like those discussed under point three, appear in the market's click-through interface.

I offer the fourth strategy for reducing liability for illegal insider trading as a bit of an experiment, one suggested by theory rather than observed practice. To implement it, a corporation need only pepper its internal market with decoy claims and prices. Why do so? In order to help protect the confidentiality of *real* claims and prices. Run-of-the-mill employees don't need to know everything about every claim traded on a corporation's prediction market, after all, because they can limit their trades to claims concerning their areas of specialization. Only a few traditional insiders, who need to oversee all of a corporation's operations, would need to know the difference between the real and fake claims on the firm's private prediction market. By keeping *that* information within the walls of its headquarters, a corporation could protect itself from allegations that it had abetted illegal insider trading, protect its non-traditional insiders from accusations of illegal trading, and protect the confidentiality—and thus the value—of corporate trade secrets generated by the private prediction market.

c. Private Prediction Markets as Gambling. Generally speaking,[43] a gambling transaction must have three elements: prize, chance, and consideration.[44] If any of the three fails to obtain, therefore, no gambling exists. A firm that wants to offer a private prediction market without running the risk of gambling should thus structure its market to avoid one or more of those elements.

Note that "open to the public" does not number among the defining features of a gambling transaction. The confidential nature of an in-house prediction market thus gives it protection from gambling laws only in practice—not in theory. Those tasked with enforcing prohibitions on gambling cannot prosecute what they never discover, granted. Furthermore, as universal toleration of "Final Four" office pools demonstrates, prosecutors typically show little interest in shutting down discretely private games.

Nonetheless, the definition of "gambling" evades sharp distinctions[45] and prosecutors enjoy wide discretion. An especially risk averse corporation might thus worry about its in-house prediction market drawing the attention of a nosy and aggressive prosecutor. How might it structure its market to defend itself against such an attack? By ruling out the elements of prize, chance, or consideration. This section discusses each in turn.

1. Prize

A private prediction market that offers players no prospect of any material benefit could not constitute gambling. Thus, for instance, an in-house market might give its top players only a pat on the back and bragging rights. Such modest rewards might suffice to induce participation in a prediction market; employees routinely perform much more burdensome tasks for no more reason than currying favor with the boss. Nonetheless, a firm might want to provide a more powerful incentive for traders to take its in-house prediction

[43] Because in the U.S. states primarily regulate gaming, no uniform federal standard exists. That makes it risky not only to generalize about gambling law, but also to rely on the leniency of any given state. True, if a firm manages to keep its private prediction market entirely within safe states, it can confidently disregard other states' laws. But that strategy could prove difficult to implement.

[44] The other two elements of a gambling transaction are prize and chance. *See*, Midwestern *Enters. v. Stenehjem*, 2001 ND 67, ¶17, 625 N.W.2d 234, 237 (2001) ("The three elements of gambling are generally recognized as consideration, prize, and chance."). It will thus protect a private prediction market from anti-gambling laws if, as argued above, the outcome of transactions on the market do not rely on chance. I here discuss the consideration element as a separate, sufficient but not necessary means of warding off the "gambling" label.

[45] *See* Hazen, *supra* note [[cite]] at p 1002 ("Speculative investing has long been viewed as tantamount to gambling.").

market seriously: valuable prizes or even cold, hard, cash. Fortunately, a private prediction markets could offer material rewards and still avoid the "gambling" label so long as the market also dodges the chance or consideration elements.

2. Chance

For a transaction to qualify as gambling, generally speaking, chance must predominate over skill in determining who wins.[46] More specifically, chance must *in theory* predominate over skill; it doesn't matter that lucky players sometimes beat skilled ones if, on average, skilled players win more.[47] Precisely because they focus on claims amenable to *prediction*, therefore, prediction markets generally fall outside the scope of anti-gambling laws.

Think of it this way: Why would anybody use a prediction market to trade in claims about something as random as, say, the spin of a roulette wheel? That sort of game just isn't worth the candle. Prediction markets, whether public or private, instead offer trading on the sort of claims that a diligent and informed person can assess more accurately than lazy or ignorant one can. Google employees who buy and sell claims on an in-house prediction market about the firm's ad revenue forecasts, for instance, will doubtless find that careful analysis serves better than dumb luck.

Luck may still play some role in deciding who wins such a claim, granted. Luck's influence pervades our lives. That does not make trading on a

[46] *See* Opinion of the Justices No. 373, 795 So.2d 630, 635-36 (Ala. 2001) (collecting authorities in support of the "American rule" that chance must dominate over skill in a gambling transaction); R. Randall Bridwell & Frank L. Quinn, "From Mad Joy to Misfortune: The Merger of Law and Politics in the World of Gambling," 72 *Miss. L.J.* 565 (2002) at p 646-60 (describing origins and content of "American rule" that chance must predominate over skill in gambling transactions); Anthony Cabot & Robert Hannum, "Gaming Law and Technology: Advantage Play and Commercial Casinos," 74 *Miss. L.J.* 681(2005) at p 682 n.3 ("The prevailing rule in the United States is that the element of chance is met if chance predominates, even if the activity requires some skill."). *But see, Boardwalk Regency Corp. v. State*, 457 A.2d 847, 852 (N.J. Super. Ct. Law Div. 1982) (holding that backgammon tournament constituted gambling because "chance plays at least a material role in determining the outcome of this activity on which money is risked, no matter how much it is claimed that the role of skill predominated . . . .").

[47] *See People ex rel. Ellison v. Lavin*, 71 N.E. 753, 754 (1904) ("[A]n event presents the element of chance so far as after the exercise of research, investigation, skill, and judgment we are unable to foresee its occurrence or non-occurrence, or the forms and conditions of its occurrence."); *Rouse v. Sisson*, 199 So. 777, 779 (Miss. 1941) ("'[I]t is the character of the game, and not the skill or want of skill of the player, which brings it into or excludes it from the prohibition of the [anti-gambling] statute.'" (quoting *Wortham v. State*, 59 Miss. 179, 182 (1881))); Bridwell & Quinn, *supra* note 153, at p 649-50 ("[T]he possession of skill should enable the skilled person in a true game of skill to win with regularity.").

prediction market the same as gambling, however. It suffices that skill proves, or in theory *could* prove, more important than luck in determining who makes the best trades on a prediction market. To avoid the reach of anti-gambling laws, therefore, a firm hosting a private prediction market need only stick to the sort of claims that skilled players are likely to win. As a happy coincidence, those are the only sort of claims that a firm will likely care about.

3. Consideration

Gambling requires, as one of its fundamental elements, that bettors stake valuable consideration on the outcome of a transaction. A firm offering a private prediction market should thus bar its agents from staking their own money on the market. That means, of course, that the firm must subsidize the market by giving players a certain amount of seed capital. At the same time, however, the firm should limit the liquidity of that capital. If title to it vested immediately and completely in a player, after all, she would effectively stake "her" money if she chose to reinvest it in the market rather than pocket it. To avoid the consideration element, therefore, the firm should both subsidize participation in its private market and limit the right of players to cash out.[48]

Though it might at first sound paradoxical, the same reasoning suggests that a firm eager to protect its private prediction market from anti-gambling laws should *require* its agents to participate. If a firm instead only *allowed or encouraged* participation, after all, it would invite the claim that its agents had staked their own time and effort in hopes of winning a prize. Legally speaking, that would suffice to show the consideration required for a gambling transaction. "Time is money," as the saying goes. If a firm would not let its agents stake their own money on the in-house prediction market, therefore, it should not let them stake their own time. To escape the reach of anti-gambling laws, a private prediction market should instead require participation as a condition of employment.

[48] What if a subsidized player wins the right to cash out but instead decides to reinvest her funds on the market? Whether or not that constitutes consideration poses a rather nice legal question. Sound public policy suggests that so long as no player risks a negative return on the market, no court should label it as "gambling." *See supra*, Figure 2 (illustrating that gambling offers only zero-sum trading). A firm unpersuaded by that analysis, and nervous about the reach of anti-gambling laws, might structure its private market to disallow reinvestment of seed capital.

PART III: THE FUTURE OF PRIVATE PREDICTION MARKETS

This Part forecasts the future of private prediction markets in the U.S. Private prediction markets have grown popular despite the pall of legal uncertainty that now surrounds them. As evidence of their utility accumulates, and as they win clearly legal status under U.S. law, private prediction markets stand to see even more use. That will, among other benefits, help to encourage the development of *public* prediction markets.

A. Towards Legal Clarity

Some of the legal uncertainty that now inhibits private prediction markets will dissipate as a matter of course, thanks simply to the passage of time and the accumulation of experience. Corporate counsels will, for instance, come to understand both the extent to which a private prediction market might increase the risk of illegal insider trading and how to design a market to manage that risk.[49]

At this point, it does not look likely that litigation or legislation will do much to clarify the legal status of private prediction markets under U.S. law. New CFTC regulations do look likely, however. The Commission recently issued a request for public comments about the appropriate regulatory treatment of prediction markets,[50] an indication that new rules might follow.

It remains possible that the CFTC might effectively regulate private prediction markets out of existence in the U.S., making a broad claim to jurisdiction over them and then smothering them under red tape. Even the most ardent regulator must recognize, however, that U.S. residents have ready access to public prediction market that operate outside the scope of domestic laws.[51] That freedom of exit will doubtless encourage the CFTC to take a largely hands-off approach towards prediction markets in general. Overly burdensome regulations would, after all, do little to stop U.S. residents from trading on prediction markets but much to drive prediction markets overseas.

Those practical limits on the CFTC's power should encourage it to write any new regulations so as to allow qualifying prediction markets to operate

[49] Perhaps reading this paper will help them; I hope it does.

[50] *See*, CFTC *Concept Release on the Appropriate Regulatory Treatment of Event Contracts*, *supra* note [[cite]].

[51] Private prediction markets would not prove quite so hard to regulate, alas, as their hosts may well have U.S.-based assets that the CFTC could effectively hold ransom. But the private nature of such markets gives the CFTC an even weaker claim over them than any claim it might have over public prediction markets. *See supra*, Part II.A.

legally, and fairly freely, under U.S. law. To judge from its current regulatory model, the CFTC will offer prediction markets a range of options, from markets that must obey relatively burdensome regulations aimed at protecting retail consumers from large losses to markets that receive relatively light regulation because they limit trading to sophisticated traders. Ideally, the CFTC would offer prediction markets something like these three tiers, each divided from the next with clear boundaries.

- **Designated Contract Markets.** Regulations designed for designated contract markets,[52] such as the HedgeStreet Exchange,[53] would apply to retail prediction markets that offer trading in binary option contracts and significant hedging functions.

- **Exempt Markets.** Regulations for "exempt" markets,[54] which impose only limited anti-fraud and manipulation rules, would apply to prediction markets that:

    - offer trading in binary option contracts;
    - thanks to market capitalization limits or other CFTC-defined safe harbor provisions[55] do not primarily support significant hedging functions; and
    - offer retail trading on a for-profit basis.

- **No Action Markets.** A general "no action" classification, similar to the one now enjoyed by the Iowa Electronic Markets,[56] would apply to any market that duly notifies traders of its legal status and that is either:

    - a public prediction market run by a tax-exempt organization offering trading in binary option contracts but not offering significant hedging functions;

[52] *See, e.g.,* CFTC, *Designated Contract Markets* (Sept. 19, 2007) at http://www.cftc.gov/industryoversight/tradingorganizations/designatedcontractmarkets/index.htm (visited May 16, 2008).
[53] *See* http://www.hedgestreet.com/ (visited May 16, 2008).
[54] *See, e.g.,* CFTC, *Exempt Boards of Trade* (Jan. 17, 2008) at http://www.cftc.gov/industryoversight/tradingorganizations/exemptmarkets/ebot.html (visited May 16, 2008).
[55] Additional limits might include requiring all such markets to aid price discovery and academic research by keeping detailed and freely available records of all trading activity.
[56] *See, Is the IEM Regulated?* http://www.biz.uiowa.edu/iem/faq.html#Regulated (visited May 17. 2008).

- a private prediction market offering trading in binary option contracts, but not significant hedging functions, only to members of a particular firm; or
- any prediction market that offers only spot trading in conditional negotiable notes.

Notably, regulation under either of the first two regimes would definitely afford a prediction market the benefit of the CFTC's power to preempt state laws.[57] It remains rather less clear whether the third and lightest regulatory regime would offer the same protection, though the cover afforded by its two "no action" letters has allowed the Iowa Electronic Markets to fend off state regulators.[58] Markets that by default qualify for the third regulatory tier described above thus might want to opt into the second tier, so as to win a guarantee against state anti-gambling laws and the like. So long as they satisfy the first two conditions for such an "exempt market" status, public prediction markets run by non-profit organizations or private prediction markets that offer trading only to members of a particular firm should have that right.[59] Why offer this sort of domestic exit option? Because it would, like the exit option already open to U.S. residents who opt to trade on overseas prediction markets, have the salutatory effect of curbing the CFTC's regulatory zeal.

For now, of course, the final form of any new CFTC regulations for prediction markets—or whether it will issue such regulations at all—remains a matter of conjecture. In the meantime, we can and should encourage the CFTC to recognize the practical and legal limits to its authority, so as to protect private and public prediction alike from inefficient regulatory burdens.[60] The status of prediction markets under U.S. law will almost certainly grow more clear, thus dispelling the uncertainty that now hinders

[57] *See, e.g.*, *Rasumussen v. Thomson & McKinnon Auchincloss Kohlmeyer, Inc*., 608 F.2d 175, 178 (5th Cir. 1979) ("[T]he Commodity Exchange Act preempts all state laws inconsistent with its provisions.").

[58] *See*, Email from Prof. George R. Neumann, Member, IEM Board of Directors, to Tom W. Bell (Jan. 29, 2007) ("We have been threatened several times with suits by various states but so far the CFTC coverage has been our trump card.").

[59] Because they fall outside the CFTC's jurisdiction, markets offering only spot trading in conditional negotiable notes could not opt into the second regulatory tier.

[60] For an effort on that front, see Tom W. Bell, et al., *Joint Comment on CFTC Concept Release on the Appropriate Regulatory Treatment of Event Contracts*, July 6, 2008, available at http://www.cftc.gov/lawandregulation/federalregister/federalregistercomments/2008/08-004.html (response to request for comments co-signed by 19 academics, professional traders, and laypeople).

their development. We need only make sure that the CFTC does not render the U.S. law clearly inhospitable to prediction markets.

B. The Effect of Private Prediction Markets on Public Ones

The growing use of private prediction markets will have a variety of beneficial effects. They will help firms operate more efficiently and, thus, profitably. Firms that treat the claims and prices of their private prediction markets as trade secrets will also, in effect, create valuable new assets.[61] The benefits of private markets go beyond simply fattening firms' purses, however. The growing use of private prediction markets will help to educate many people—not only the people who trade on private prediction markets but also the academics and policymakers who monitor such things—about how prediction markets in general work. In that way, the success of *private* prediction markets stands to help *public* prediction markets succeed, too.

Private prediction markets could encourage the development of public prediction markets through a more direct and intentional route, too: By gradually expanding the boundaries of "private."[62] In step one of that process, a firm would set up a private prediction market open only to its employees. Per the guidelines described above,[63] the firm would make playing the market a condition of continued employment and offering valuable prizes to the best traders. In step two, the firm would open the market to a select number of independent contractor researchers, paying each a relatively low salary simply for trading on the market. That salary might, for instance, be set at a penny per trade and capped at 100 trades/day. Strictly speaking, the firm would pay those independent contractors for the valuable information gleaned from their trades, whether those trades beat the market or not. Significantly, however, the firm would offer valuable prizes to those whose trades best track the truth. In the third and last step, the firm would offer that same arrangement to any internet user willing to agree to a click-through license, the terms of which would qualify him or her as an independent contractor researcher.

That stepwise process would make it easy for a firm to test the legal

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[61] *See supra*, Part II.B.2.b.

[62] I first described this in a presentation, Getting from Collective Intelligence to Collective Action, Collective Intelligence FOO Camp, Google & O'Reilly Media, the Googleplex, Mountain View, California, February 22, 2008, available at http://www.tomwbell.com/writings/CIFOO_PM_Legalization.ppt. See also, Tom W. Bell, "Getting from Collective Intelligence to Collective Action," Agoraphilia (Feb. 28, 2008), http://agoraphilia.blogspot.com/2008/02/getting-from-collective-intelligence-to.html (visited May 17, 2008) (describing presentation).

[63] *See supra*, Part II.C.

waters gradually, without plunging into the risk of full liability. When and if standing for declaratory judgment obtains, the firm could bring suit to establish the legality of the private prediction market under U.S. law. In the event of any such test case, it would greatly help if the market were run by a worthy institution and if it dealt only in claims likely to generate large positive externalities. Google.org, for example, might set up a private prediction market in earthquake claims and ask for a court's blessing at each stage of the market's expansion, from its genesis as a market open only to firm management to a market open to all willing independent contractor researchers.

Executed properly, this sort of campaign would stand a fair chance establishing the legality under U.S. law of a wide range of private prediction markets. The effort would not impose great costs or risks, though it would take some careful planning and execution. On the upside, it would almost certainly generate large private and public goods. Imagine, for instance, if it helped us to establish an reliable early-warning system for major earthquakes. This strategy would directly benefit only subsidized markets, however; it would not suffice to establish the legality of prediction markets that allow traders to invest their own funds or hedge against off-market risks. Even so, all sorts of prediction markets would win great respectability if we could establish the legality of real-money open-access, private prediction markets under U.S. law.

CONCLUSION

This paper has described the legal risks facing private prediction markets under U.S. law and how firms that want to run such markets should adapt. To minimize the risk of CFTC regulation, firms should institute mechanisms to ensure that their private prediction markets do not support significant hedging functions and make clear, both in the documentation supporting their markets and in their markets' structures, that they offer trading not in binary option contracts but rather in conditional negotiable notes. Publicly-traded firms subject to U.S. law can minimize the risks of illegal insider trading by either making public all prices and claims traded on their prediction market or by:

- Keeping trading by traditional insiders separate from trading by others;
- Broadening safeguards against illegal insider trading to cover all traders;
- Treating the market's claims and prices as trade secrets; and/or

- Seeding the market with decoy claims and prices.

Although the skill-based trading emphasized on private prediction markets should in theory remove them from the scope of gambling regulations, a prudent firm could help to ensure that result by:

- Forbidding traders from investing their own funds in the market; and/or
- Requiring its agents to participate in its market.

As should perhaps go without saying (but as hereby will not), any firm implementing these legal strategies should back them up with ample record-keeping. Each person who trades on a firm's market should, for instance, receive clear notification that the market does not deal in CFTC- or SEC-regulated instruments, and that it does not offering services subject to oversight by any state gambling commission. Better yet, traders should be required to access the market only through a click-through agreement in which, among other things, they consent to that stipulation. So go only a few of the provisions that ought to appear in such an agreement; any reasonably competent attorney will think of many worthwhile provisions to add.

Private prediction markets will almost certainly escape the legal uncertainty that now clouds their prospects in the U.S. Even if no legislator, judge, or regulator ever notices them, private prediction markets will come to win *de facto* legality simply by merit of their widespread use and acceptance. With reflection—perhaps aided by papers such as this one—and practical experience, attorneys will learn how to structure private prediction markets to accommodate the laws that rightfully apply to them and to dodge the effect of laws written for other, materially different markets. There remains some risk, granted, that the CFTC will crush private prediction markets under new regulations. With luck though—and perhaps also with some persuasion—the CFTC will instead allow prediction markets to choose from among several different tiers of regulations. And even in the worse-case scenario, private prediction markets will not disappear; they will simply flee the U.S. for other, freer homes.

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COMMENT ON BELL ARTICLE

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Almost by definition, all disruptive technologies or innovations threaten vested interests. If markets and the legal environment are sufficiently flexible – and in the United States, for the most they are – innovations that buyers want diffuse throughout the economy despite the opposition.

There are cases, however, where the existing order uses the legal system to fight back, to forestall or delay change. Napster is a case in point: it threatened the established recording industry, which eventually persuaded the courts to shut down that particular form of peer-to-peer file transfer. But even in this case, "the law" has failed to stop innovation. Other peer-to-peer networks have found ways to legally permit free Internet-based file transfers, while some companies – notably Apple – have developed business models around paid file transfer.

As other papers in this volume make clear, prediction markets represent yet another disruptive innovation. Who might they threaten, and will the law get in way?

Tom Bell implicitly, if not explicitly, answers this question in his important survey of the legal issues raised by prediction markets. Both federal regulators and in-house lawyers of major companies that could benefit from allowing their employees to participate in even limited prediction markets, for different reasons, appear to have some anxiety about allowing such markets. Regulators seem to be wary of encouraging speculation, or permitting prediction markets to become vehicles for money laundering. In-house lawyers are nervous of running afoul of various federal securities and commodities trading laws and regulations, overseen by the Securities and Exchange Commission (SEC) and the Commodities Futures Trading Commission (CFTC), respectively. In short, the law indeed is inhibiting the diffusion of prediction markets, and Bell's excellent article explains how.

One obvious way in which federal regulators could improve the legal climate would be to provide a safe harbor for prediction markets that meet certain conditions. This they have done for public markets like the Iowa Presidential exchange: most importantly, the stakes must be small. At this writing, the CFTC also has announced its intention to construct a different safe harbor for in-house corporate prediction markets. Bell outlines in his article some useful principles for the CFTC to follow when it finally gets

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ready to implement this idea. The most important one: keep federal hands off of these markets, to the extent possible.

Even a relatively broad safe harbor from the CFTC, however, may not give in-house corporate lawyers the legal certainty they need to feel comfortable. The CFTC cannot tell the SEC how to exercise its jurisdiction. Further, the extent to which a safe harbor from the CFTC would preempt state gambling laws, especially in this context, may have to be litigated to provide clarity.

One issue which is outside Bell's purview, but which nonetheless also could slow the adoption of prediction markets by corporations relates to organizational behavior. Prediction markets have the potential to have similar or maybe even more profound impacts on large corporations as spreadsheet software once did (and may be still be having). Programs like Excel gave huge power to senior executives who knew how to use it, and thereby threatened the usefulness and ultimately the jobs of large numbers of middle managers whose job was to gather and process information.

Likewise, by harnessing the "wisdom of crowds," prediction markets threaten to trump the judgment of designated "experts" within corporate structures. Those experts understandably might try to resist, either by keeping their companies from using such markets in the first instance, or by finding various ways to sideline or slow the use of those markets if they somehow penetrate the palace gates.

Fortunately, for the companies profiled in this volume, these kinds of corporate roadblocks do not yet appear to have been a major problem. But I suspect that for other companies, they have been or will be. For these companies, even greater legal certainty thus will not lead to greater use of prediction markets.

My guess, therefore, is that if enlightened lawyers follow the advice outlined by Tom Bell, prediction markets will gain surer footing in the marketplace the old-fashioned way: through the force of competition. Companies that gain an edge in the marketplace because of better forecasts eventually should induce others to follow in their wake. If prediction markets don't deliver much benefit, however, then even constructive legal reform can't ensure their use.