**IN THE UNITED STATES DISTRICT COURT
FOR THE WESTERN DISTRICT OF TEXAS**

KEVIN CLARKE, in his individual capacity, TREVOR BOECKMANN, in his individual capacity, HARRY CRANE, in his individual capacity, CORWIN SMIDT, in his individual capacity, PREDICT IT, INC., a Delaware corporation, and ARISTOTLE INTERNATIONAL, INC., a Delaware corporation, Plaintiffs, v. COMMODITY FUTURES TRADING COMMISSION, Defendant.	Case No. 22-cv-00909-LY

**APPENDIX TO PLAINTIFFS'
MOTION FOR PRELIMINARY INJUNCTION**

IN THE UNITED STATES DISTRICT COURT
FOR THE WESTERN DISTRICT OF TEXAS

KEVIN CLARKE, in his individual capacity, TREVOR BOECKMANN, in his individual capacity, HARRY CRANE, in his individual capacity, CORWIN SMIDT, in his individual capacity, PREDICT IT, INC., a Delaware corporation, and ARISTOTLE INTERNATIONAL, INC., a Delaware corporation,	Case No. 2022-cv-00909
Plaintiffs,	
v.	
COMMODITY FUTURES TRADING COMMISSION,	
Defendant.	

DECLARATION OF DEAN PHILLIPS

Pursuant to 28 U.S.C. § 1746, I, Dean Phillips, do hereby declare:

1.   My name is Dean Phillips. I am the President and Co-Founder of Aristotle International, Inc. ("Aristotle"). I submit this declaration in support of Plaintiffs' Motion for a Preliminary Injunction.

2.   I have personal knowledge of the facts stated herein.

3.   In 2014 Victoria University of Wellington ("Victoria University") petitioned for and was granted no-action relief from the CFTC, allowing it to operate a political-event contract market. A true and correct copy of Victoria University of Wellington's Request for No-Action Letter for a Small-Scale, Not-For Profit, Event Futures Market for Educational Purposes (the "Request") is attached hereto as Exhibit 1. A true and correct copy of the CFTC Letter No. 14-130 (the "No-Action Relief") is attached hereto as Exhibit 2.

4.   Aristotle International, Inc. assisted Victoria in assembling that application and shepherding it through the CFTC's regulatory process. Once the CFTC issued the decision that permitted the Market to open, Victoria entered into a contract with Aristotle International Inc. and its subsidiary Predict It, Inc. ("PredictIt") to serve as clearing house and support the Market on the day-to-day basis.

5.   Aristotle invested over seven million dollars to stand up the PredictIt Market, after the agency's decision to permit its operations. It developed a software backbone and internet interface for the Market. It hired, trained, and maintains an employee base of seven fully dedicated (full time) employees and 18 employees who split time between PredictIt and other Aristotle businesses to clear trades and to ensure compliance. It established policies, procedures, and a compliance environment to ensure that the Market is not misused. All this and more was performed pursuant to a market-servicing agreement with Victoria. Specifically, PredictIt serves as the internet distributor of the user-generated predictive content offered on the PredictIt Market. Aristotle and PredictIt's investments have resulted in the technological infrastructure for the PredictIt Market, including the design of the Market's trading engine, clearing operations, state-of-the-art investor due-diligence systems, and anti-money-laundering controls.

6.   Since its inception and throughout its operation, the PredictIt Market has imposed certain restrictions on trader investments pursuant to the terms of the No-Action Relief. Traders may not invest funds in excess of $850 in any one event contract, and the number of active investors in any one event contract is limited to 5000.

7.   Within these limitations, the Market hosts dozens of contract markets at a given time, each of which includes one or more questions about the outcome of a future political event.

Each question is binary—having a yes or no answer—and investors' positions on the answer to each question are known as "contracts."

8.   Each contract is traded for prices less than one dollar that reflect the probability of various event outcomes occurring based on traders' collective beliefs. When the event ultimately occurs, contracts predicting the correct outcome are redeemed for one dollar while incorrect predictions receive no payout.

9.   The subject matter of each event contract offered on the Market is related to the outcome of future elections and other significant political events, as authorized by the No-Action Relief. Victoria University's Request for No-Action Relief sought approval to issue contracts concerning the outcome of elections and other "significant Political Events," unrelated to "terrorism, assassination or war." Ex. 1 at 3. The No-Action Relief, approving the scope of the proposed definition of political event contracts in the Request, summarizes that "the proposed submarket for political event contracts will include winner-take-all contracts to predict the following outcomes:

- Which presidential nominee will win his or her party's primary, the general election popular vote, and the Electoral College;

- Who will be the major party nominee for Vice President; and

- Which party will control the next Congress."

Ex. 2. The letter made clear that the examples listed were not exclusive by using the word "include" and referenced approvingly, summarized, and made no apparent attempt to constrict the description of the proposed political event market in Victoria University's request for no-action relief. *Id.*; Ex. 1. Further, in a 2014 email, the CFTC Division of Market Oversight's Chief Counsel David Van Wagner acknowledged that the three examples of political contracts were "non-exclusive." A true and correct copy of the 2014 email is attached hereto as Exhibit 4.

3

10.   On August 4, 2022, the CFTC revoked the No-Action Relief in CFTC Letter No. 2208 (the "Revocation"). A true and correct copy of the Revocation is attached hereto as Exhibit 3.

11.   The Revocation generally describes the terms of the No-Action Relief and summarily states that Victoria University "has not operated its market in compliance with the terms of [the No-Action Relief]." Ex. 1 at 2. The Revocation further orders that all PredictIt contract markets close or liquidated by February 15, 2023, prohibits listing of new or related contracts, and orders the immediate liquidation of contract markets not operating "in a manner consistent with each of the terms and conditions provided" in the No-Action Relief. *Id.*

12.   In the absence of an explanation from the CFTC of why or how the agency believes the PredictIt Market is not operating in compliance with the terms of the No-Action Relief, there is no clear way to determine which of the Market's contract markets are purportedly noncompliant and must be liquidated immediately.

13.   In nearly eight years of operation of the PredictIt Market, 177,293 individual investors have traded in 8,059 markets including 4,483 on the outcome of elections and other significant political questions. During the year prior to the Revocation, 35,664 unique traders participated in 728 separate markets hosted on the PredictIt Market, investing in more than 14,000 event contracts predicting the outcome of elections and other significant political questions. When the Revocation was issued, PredictIt hosted roughly 550 event contracts.[1]

14.   Of the contracts that will close before the February 15, 2023 shut-down date, it is uncertain which are part of contact markets the CFTC believes are being operated "in a manner

---

[1]   Of the 728 contract markets hosted by the PredictIt Market during the year preceding the Revocation, 178 closed—their deciding event occurred—before the Revocation was issued.

[in]consistent with . . . the terms and conditions" of the No-Action Relief and must be liquidated immediately.

15.   Even assuming all PredictIt Market contract markets are operating within the parameters of the No-Action Relief, at least 75 event contracts—in which 14,478 traders have invested—would not ordinarily close until after the February 15, 2023 shut-down date, but for the Revocation. Many of the contracts concern the outcome of various U.S. elections in 2024 cycle, including the U.S. presidential primary and general elections. These presidential election contracts generally have been the most watched and frequently traded contracts PredictIt offers.

16.   For event contracts that must be liquidated before their deciding event occurs, there is no standard by which they should be valued. Ordinarily, these contracts could be traded up to their deciding event at which time contracts predicting the correct outcome are redeemed for one dollar and incorrect-outcome contracts become valueless. For prematurely liquidated contracts, it is unclear whether those contracts should be cashed out at their value on the date of liquidation, at the value for which they were purchased, or for some other amount.

17.   This premature liquidation and uncertainty regarding which contract markets must be liquidated and when are subjecting Aristotle and PredictIt to massive administrative, labor, time, and other costs. Since the Revocation, Aristotle and PredictIt personnel have met daily to determine how and when PredictIt Market contract markets must be shut down and to address the many investor calls and emails seeking clarity on if, how, and when PredictIt Market contracts will be liquidated. Even when the correct timing and manner of premature liquidation is determined, numerous systems must be set up—including software infrastructure—to effect a premature payout. The development of these systems will require programmers, accountants, and financial

analysts to expend at least 2,500 hours of time and effort. And Aristotle and PredictIt will bear

the cost associated with their labor, which we are currently budgeting in the amount of $250,000.

I declare under penalty of perjury that the foregoing is true and correct.

Executed on September 28, 2022

_____

Dean Phillips

Exhibit 1

June 26, 2014   <u>Request Under 7 U.S.C. Sec. 6(a)</u>

Vince A. McGonagle

Director

The Division of Market Oversight

Commodity Futures Trading Commission

Three Lafayette Centre

1155 21st Street, NW

Washington, DC 20581

      RE: <u>VICTORIA UNIVERSITY OF WELLINGTON'S REQUEST FOR NO-ACTION LETTER FOR A SMALL-SCALE, NOT-FOR PROFIT, EVENT FUTURES MARKET FOR EDUCATIONAL PURPOSES</u>

Requester:

Victoria University of Wellington

Macdiarmid Building, Am404

Kelburn Parade

Wellington, 6012, New Zealand

Phone:

Dear Mr. McGonagle:

      On behalf of Victoria University of Wellington, New Zealand ('Victoria University' or "the University') I am writing to request a no-action letter from the Division of Market Oversight to permit the establishment and operation of a not-for profit, event futures market and offer event futures contracts to U.S. persons without registering as a designated contract market under Section 5 of the Commodity Exchange Act.

Proposal

      Victoria University proposes the creation of a small-scale, not-for-profit, electronic real-money event futures market in the U.S. for educational and research purposes. The venture will be modelled

042540001/2008447.1   1

after the Iowa Electronic Market (IEM), which has operated for more than 20 years under two no-action letters from the CFTC.[1] The University intends to establish a subsidiary (to operate on a not-for-profit basis) in the U.S. for the project.

Certain changes are proposed to the IEM model. These changes are intended to insure that the system produces more accurate results and fulfills the educational public interest purpose of the project. As more specifically described below, we intend to accomplish this by offering upgraded technology that we consider more user- friendly, eliminating any upfront user fee, increasing the number of participants, raising the 1992 dollar limits to 2014 levels, employing Know-Your-Customer authentications to strengthen the integrity of the system, requiring that users be at least 18 years old, and facilitating ease of registration, deposits and withdrawals.

Given the important academic and educational benefit we hope to be derived from this research and the purposes and manner of operation of the proposed market, the University believes that the market will be a valuable academic tool and entirely consistent with the public interest. However, because the proposed contracts would be available to U.S. persons, we are concerned that, absent the relief requested in this letter, the operation of the proposed market without obtaining designation as a contract market would be prohibited by the Commodity Exchange Act (the "Act") and the regulations promulgated thereunder.[2] Accordingly, the University seeks confirmation from the Division that it will not recommend enforcement action against the University or its agents for operating the proposed market and offering event contracts without contract market designation.

Description of the Market:

Customized software will be used to operate a market-based political and economic forecasting system. The University's key employees overseeing the project will be three University professors and one administrator. Neither the professors nor the administrator will receive any compensation or other payment, directly or indirectly, for operating the markets. Neither Victoria University nor any of the key personnel operating the proposed markets is required to register with the Commission, nor is any of these persons or entities a business affiliate of any person required to register with the Commission.

The written and other descriptive materials concerning the Proposed Market will prominently disclose that this is an experimental, research-based market that is being operated for academic purposes, and is not regulated by, nor are its operators registered with, the Commodity Futures Trading Commission or any other regulatory authority.

Educational Purposes and Uses of Market Information:

The University proposes to utilize the results of the market information for educational and research uses and purposes, including: courses in statistical analysis, market theory, and trader psychology; and to publish related research papers and analyses. Like IEM, the results may be made available to other participating academic institutions for the same purposes.

Examples of Contracts to be Offered

Political Event Contracts. As with IEM, we hope the market will be open to users worldwide.[3]

Political Event Contracts will include the following:

---

[1] *See* http://www.cftc.gov/ucm/groups/public/@lrlettergeneral/documents/letter/92-04a.pdf and http://www.cftc.gov/ucm/groups/public/@lrlettergeneral/documents/letter/93-66.pdf
[2] 7 U.S.C Sec. 1 *et seq.*, and Commission rules and regulations found at 17 C.F.R Part 34.
[3] *See* http://tippie.uiowa.edu/iem/faq.html#who ("The IEM is operated for research and teaching purposes. All interested participants world-wide can trade in our political markets.")

- Presidential Elections Submarket:
    - o Winner-Take-All contracts to predict which presidential candidate will win their parties' primaries, the general election popular vote, and the Electoral College;
    - o Winner-Take-All contracts to predict who will be the major party nominees for Vice President
    - o A Vote Share contract to predict what percentage of the vote the two major party candidates will receive
- Congressional Control Submarket to predict which party will control the next Congress.
    - o Congress 2014 contract-- based on the composition of both houses of Congress
    - o House2014 contract -- based on the composition of the U.S. House of Representatives
    - o Senate2014 contract -- based the composition of the U.S. Senate
- Other Significant U.S. Elections Submarket
    - o Contracts to predict the outcome of other significant U.S. Elections not falling within the other markets
- International Elections Submarket
    - o Contracts to predict the outcome of certain foreign elections, such as the Canadian elections described in the 1993 IEM no-action letter.

Economic Indicator Contracts

- Federal Reserve Monetary Policy Winner-Takes-All.
    - o The Federal Reserve Monetary Policy Submarket B (FedPolicyB) is a real-money event contract. Contract payoffs are determined by monetary policy decisions of the Federal Open Market Committee regarding the federal funds target rate.

The market may list additional event-driven contracts based on significant Political Events. It may also list additional Economic Indicator Contracts. However no Economic Indicator Contracts shall compete with any contracts that are listed by a regulated contract market at the time of listing by the market and the market shall not list more than 5 Economic Indicator Contracts at any one time. Participation in Economic Indicator Contracts shall be limited to students, faculty and staff at any participating universities. The market will not list any contracts that involve, relate to or reference terrorism, assassination or war.

Structure of Contracts

Shares are initially priced at $1. Contracts for the correct outcome pay off at $1. All other contracts pay off at zero. As a result, the price of the contract at any given time is the probability that the traders believe that event will happen. There will be no additional fees other than those necessary to cover the basic expenses of running the market, including the University's expected costs and those of any service providers as described herein. Participants will execute their own trades, and no brokerage service will be available or allowed. Participants will invest their own funds, buy and sell listed contracts, and bear the risk of loss.

Know Your Customer Requirements

The University intends that an age and identity verification process be employed that will follow Know Your Customer Requirements ("KYC"). The KYC process, performed by an established and credible third party, is a critical and essential component of our proposed system, and a major difference from IEM's structure. KYC will be implemented to strengthen the overall integrity and stability of the system and to improve the accuracy of the results, by reducing the likelihood of fraud, market manipulation, use of the system by minors, and excessive amounts being deposited by individuals using multiple accounts. This process will be operated by a third party, Aristotle International, Inc., whose Integrity authentication service is a leading global provider of age and identity verifications for government and business, having successfully performed over 50 million authentications. Aristotle is also one of only 6

Federal Trade Commission-approved Safe Harbors for compliance with the Child Online Privacy Protection Act COPPA. A description of Aristotle and its Integrity Service can be found at http://integrity.aristotle.com/.

Number of Traders in Each Market

IEM is limited to 2000 total traders in any particular election. We propose raising the limit to 5000 total traders in any particular election.

As the purpose of the market is an academic and educational tool, restricting the number of participants too greatly is likely to result in a market that is not as close to an efficient and effective a prediction tool as it could be and therefore impacts the value of the academic research generated by the project.

Specifically, there is nothing in the way of academic or comparative study to justify or even suggest that IEM's limitation is needed to optimize the accuracy of the market. What is known is that there are compelling reasons to raise the limit on the number of traders participating in a market:

1. Prediction markets work because they aggregate information from "a group of traders, and groups are almost always smarter than the smartest people in them."[4]
2. Thinly-traded contracts give single users an outsized voice in the market, creating the potential for results that skew in one direction or the other.[5]
3. A limited trader base will restrict the number and nature of prediction questions, as there will be too small a trading base for specialized questions or regional questions. Prediction questions with few participants are illiquid and have limited appeal to participants. Greater market liquidity is linked to market accuracy. Without liquidity there is less incentive to trade and therefore less information sources available to the market. In our experience this concentrates trading into a small number of prediction stocks and limits the market scope.
4. Limiting participant numbers limits informational sources for the market. The purpose of the market is to bring into the public domain private information. Prediction markets are successful because they are informationally efficient. Restrictions on participation may lead to the market not factoring in some available information, directly reducing accuracy.

---

[4] *See* http://www.utsandiego.com/news/2010/feb/01/1c01prediction/ quoting James Surowiecki in his 2004 book, "The Wisdom of Crowds".

[5] *See, e.g.,* **Betting on a future market,** http://www.nbcnews.com/science/betting-future-market-6C10405016?franchiseSlug=sciencemain; *See also,* Betting on Politics--and Getting it Right, CNN November 16, 2011 http://tippie.uiowa.edu/iem/media/story.cfm?ID=2718 :

> "Many of the markets are thin, and that's a problem," Fair said....Thinly traded contracts give single users an outsized voice in the market, creating the potential for results that skew in one direction or the other. And around the margins—when a candidate stands very little chance of winning, or has already locked up the race—the market becomes far less perfect," Fair said.

See also, **Prediction Markets Are Hot, But Here's Why They Can Be So Wrong** (May 19, 2008) Wired Magazine, http://archive.is/eZ0E5#selection-1877.9-1877.691 :

> Like financial markets, prediction markets are big information processors, distilling the collective wisdom of their traders. But the success of any market depends upon the stakes and the pool of traders. Most prediction markets aren't anywhere near as robust as those they emulate on Wall Street. "They are thin, trading volumes are anemic, and the dollar amounts at risk are pitifully small," market analyst Barry Ritholtz wrote in January. That opens them up to all kinds of problems as information processors. Political markets, for example, have a lot of political junkies but few real insiders or outsiders, so they're not very good at catching something the polls might miss.

042540001/2008447.1   4

5. When there is too small a cap as with IEM, people who sign up, but who do not participate or who participate very infrequently, are effectively blocking legitimate participants who could better help the market to realize its beneficial educational purpose.
6. Although IEM has frequently been praised for beating the polls a large percentage of the time, this does not mean that the IEM market is as accurate as it could be, or that IEM is beating the polls as often and by as large a margin as it could.
7. In a letter written by 22 professors who are experts in prediction markets (including those professors who operate IEM), although a "modest" annual cap on deposits by an individual was proposed, they specifically did not propose a limit on the number of participants.[6]
8. Limiting the maximum number of traders too severely can greatly limit the ability to add additional sponsoring universities, a consequence that severely undercuts the educational reach and purpose of the market.
9. We do not anticipate that more than a few thousand traders will participate in any particular election, other than for U.S. President. We expect that the level of public interest in a particular contract will in fact be the strongest and most natural limiting factor. However, where there is a particularly significant event contract in which many thousands more would want to participate, then rejecting those participants would utterly defeat the educational purpose of the project.

We therefore propose that the number of traders in any particular election be increased to 5000. We are of the strong opinion that greater limits on participants will significantly undermine the academic utility of the project. We anticipate that the higher cap proposed, coupled with a slightly higher maximum deposit limit (discussed below), will make the proposed markets more efficient by minimizing the likelihood of thinly-traded contracts, while preserving the small-dollar, educational purpose of the project, similar to IEM.

Markets Open to Non-Academic Traders

We also propose that Political Event Contracts not be limited to a fixed minimum percentage of "academic traders", such as the students and staff of educational institutions. There is nothing to suggest that any such limit used by IEM is in any way related to the educational purpose or the accuracy of the market, or has been justified by any comparative studies. Many of the same reasons stated above for expanding the number of traders would also logically apply to this issue as well.

There is simply no reason to believe a fixed minimum of academic participants will help with educational and research purposes of the market. In fact this is likely to bias the markets and reduce access to a broader range of informational sources therefore reducing accuracy. The primary educational and research purposes of the market rely on the market being informationally efficient and accurate. We also foresee a number of questions that will provide useful information for researchers, in which questions one would not want a quota for academic participation especially where the public debate is already led or heavily influenced by academics.

---

[6] *See* **The Promise of Prediction Markets.**, Science 16 May 2008, http://www.sciencemag.org/content/320/5878/877.full .
See also, **Betting on a future market**, NBC News, Science, http://www.nbcnews.com/science/betting-future-market-6C10405016?franchiseSlug=sciencemain . The Researchers making this request, and their affiliations at the time, were: Kenneth J. Arrow, Paul Milgrom and Erik Snowberg of Stanford University; Robert Forsythe of the University of South Florida; Michael Gorham of the Illinois Institute of Technology; Robert Hahn of the American Enterprise Institute; Robin Hanson of George Mason University; John O. Ledyard of the California Institute of Technology; Saul Levmore and Cass R. Sunstein of the University of Chicago Law School; Robert Litan of the Kauffman Foundation; Forrest D. Nelson and George R. Neumann of the University of Iowa; Marco Ottaviani of Northwestern University; Thomas C. Schelling of the University of Maryland at College Park; Robert J. Shiller and Paul C. Tetlock of Yale University; Vernon L. Smith, Philip E. Tetlock and Hal R. Varian of the University of California at Berkeley; Justin Wolfers of the University of Pennsylvania; and Eric Zitzewitz of Dartmouth College

<u>Amount of Trader Investment</u>

Under the 1992 and 1993 no-action letters addressing the original IEM proposals[7], the "maximum investment by any single participant in any one Submarket is $500." IEM continues to use that limit. However, using the Consumer Price Index, $500 in 1992 had the same buying power as $844.99 in 2014[8]. Therefore, we propose raising the limit to $850, to allow participants the ability to participate in several more contracts than they might otherwise if limited to 1992 levels. This will make the proposed markets more efficient by minimizing the likelihood of thinly-traded contracts, while preserving the small-dollar, research and academic purpose aspects of the IEM. This $850 limit also compares favorably with the $2000 annual investment limit recommended by 22 researchers (including two of the IEM's co-founders) in their 2008 request to Congress and the CFTC to clear up uncertainty in the regulation of prediction markets.[9]

<u>Methods of Registration</u>

The system will be employed to allow electronic registration to facilitate trader participation, while simultaneously safeguarding against duplicate or multiple accounts for the same user, or registration by minors. These registrations will be verified and authenticated through the KYC process to be provided by Aristotle's Integrity, and can take place in real-time.

<u>Methods of Deposit/Withdrawal</u>

Complementing the efficiency of electronic registration, and to otherwise make the proposed market system easier to use, the system will allow credit card deposits and withdrawals for those authenticated through the Integrity KYC process. Those transactions will be processed through Aristotle, which has years of experience handling such transactions. For example, Aristotle's Integrity service has processed over 50 million authentications using a database of government-issued ID and other government records. Aristotle also is an experienced processor, well versed in regulatory reporting and compliance, having handled millions of dollars in campaign contributions over the years for hundreds of candidates and political action committees through its service at www.campaigncontribution.com .

<u>User Fees/Covering Costs</u>

Neither the University nor its key personnel operating the market will receive any compensation or other payment for operating it. The pricing for the project will be set to cover anticipated regulatory compliance and operating costs. At this time, it is projected that, unlike IEM, the market terms will not require any upfront charge or fee. The only user fees will be those designed to cover for costs of credit card processing of deposits and withdrawals, fulfillment of the KYC process, and all other regulatory compliance and operating costs.

<u>Marketing</u>

We understand that one aspect of the IEM, as spelled out in the no-action letters, was that no one involved in the operation could engage in any "advertising" of the IEM. However, the IEM market would be less efficient, and therefore less valuable from a research standpoint, if the markets draw an inadequate pool of participants as a result of the marketing restrictions. It is the University's view that, in order to reach a pool of widely dispersed but interested political users, one must do limited advertisement to attract sufficient and diverse users to the market. The University believes that the reason that significant research based upon the data derived from prediction markets has been limited is due to a failure to reach a wider audience. Moreover, although IEM may not do "advertising", it does

---

[7] *See* http://www.cftc.gov/files/foia/repfoia/foirf0503b002.pdf
[8] *See*, e.g., http://www.dollartimes.com/calculators/inflation.htm
[9] *See n. 7, supra.*

appear that it engages in promotional activity such as press releases[10] and links to earned media[11]. In short, we believe that the limitations on the modest amounts to be invested, together with efficient KYC controls to prevent multiple accounts and participation by minors, will be sufficient to preserve the non-commercial nature of the proposed markets without prohibiting limited efforts to publicize our activities. Any such promotional activities would contain a disclosure that the market is unregulated, and would be limited by targeting only media outlets where there is a high likelihood of reaching those interested in the subject matter of the contracts at hand. Promotional activity would not be directed at the general retail investing public.

Experimental Nature of Prediction Markets

Finally, as noted above, although IEM is reported to perform generally better than polls, this does not mean that the structure developed for IEM in the late 1980's, and approved by the CFTC in the 1992 and 1993 no-action letters, is optimal for an educational market. As the 22 leading academics wrote in their 2008 letter to the CFTC:

> The CFTC should allow researchers to experiment with several aspects of prediction markets—fee structures, incentives against manipulation, liquidity requirements and the like—with the goal of improving their design. Prediction markets are in an early stage, and if their promise is to be realized, researchers should be given flexibility to learn what kinds of design are most likely to produce accurate predictions. Of course, exchanges would need to inform their customers so that they are aware of the risks and benefits of participating in these markets.

Given that the market we propose is a small-money market, and has far greater safeguards than IEM to preserve the integrity of the operation, we believe that the design we have proposed will be in the public interest.

If you have any questions or require additional information, please do not hesitate to contact the undersigned.

Respectfully submitted,

Victoria University of Wellington

By: _____

Neil Quigley
Deputy Vice-Chancellor, Research

---

[10] *See, e.g.*, http://tippie.uiowa.edu/iem/media/releases.cfm
[11] *See, e.g.*, http://tippie.uiowa.edu/iem/media/news_current.cfm

042540001/2008447.1   7

Exhibit 2

U.S. COMMODITY FUTURES TRADING COMMISSION

Three Lafayette Centre
1155 21st Street, NW, Washington, DC 20581
Telephone: (202) 418-5260
Facsimile: (202) 418-5527

Division of
Market Oversight

CFTC Letter No. 14-130
No-Action
October 29, 2014
Division of Market Oversight

Neil Quigley
Deputy Vice-Chancellor, Research
Victoria University of Wellington
Macdiarmid Building, Am404
Kelburn Parade
Wellington, 6012, New Zealand

      Re: Victoria University of Wellington's Request for No-Action Letter regarding the
Operation of a Small-Scale, Not-For-Profit Market for the Trading of Event
Contracts for Educational Purposes

Dear Mr. Quigley:

This letter is in response to your letter to the Division of Market Oversight ("DMO" or
"Division") of the Commodity Futures Trading Commission ("CFTC" or "Commission) dated
August 26, 2014, requesting no-action relief that would allow Victoria University of Wellington,
New Zealand ("Victoria University")[1] to operate a not-for-profit market for the trading of event
contracts and the offering of such event contracts to U.S. persons.

As you note in your letter, the Division of Trading and Markets ("T&M"), which preceded DMO
as the CFTC division with oversight responsibilities for regulated markets, granted no-action
relief by letter dated June 18, 1993, to the University of Iowa to permit the operation of a non-
profit electronic market ("Iowa Electronic Markets" or "IEM").[2] The IEM consists of
submarkets for binary contracts concerning political elections and economic indicators — it is
operated for academic research purposes only, and its operators, who are faculty at the
University, receive no separate compensation.

---

[1] Victoria University was founded as Victoria College in 1897. The University comprises four campuses, more than
2,000 staff and 16,000 students. Additional information about the University's history, faculty, academic offerings,
reputation, rankings, and related matters is available at http://www.victoria.ac.nz/about/.

[2] CFTC No-Action Letter No. 93-66 (June 18, 1993), *available at*
http://www.cftc.gov/ucm/groups/public/@lrlettergeneral/documents/letter/93-66.pdf.

Victoria University proposes the creation of a small-scale, not-for-profit, online market for event contracts in the U.S. for educational purposes that will use the IEM as a model, with certain features that would vary from that model. As such, you request on behalf of Victoria University similar no-action relief with respect to the operation of your proposed market for event contracts as was granted to the University of Iowa with respect to operation of the IEM. In particular, you request that DMO recognize that Victoria University's market for event contracts, as proposed, should not be required to register as a designated contract market ("DCM") under section 5 of the Commodity Exchange Act ("CEA") and part 38 of the Commission's regulations, nor as a foreign board of trade ("FBOT") under section 4 of the CEA and part 48 of the Commission's regulations, and that its operators need not register under the CEA or the Commission's regulations.

I. Background

Based upon the representations contained in your letter, as supplemented by telephone conversations with DMO staff, we understand the facts to be as follows. Victoria University (henceforth "University") intends to operate two submarkets: one for political event contracts, and the other for economic indicator contracts. The University proposes to utilize the results of the market information derived from trading in these contracts for educational and research purposes. For example, the University plans to utilize the results from its market as teaching tools in its courses on statistical analysis, market theory, and trader psychology. The University has also expressed plans to utilize the results to publish related research papers and analyses.

All of the proposed event contracts would be structured as follows:
- all contracts would be initially priced at $1;
- each contract for the correct outcome would pay off at $1, while all other contracts (i.e., contracts with incorrect outcomes) would not pay-off; and
- the price of each contract at any given time would reflect the probability that the traders believe that the event will happen.

The proposed submarket for political event contracts will include winner-take-all contracts to predict the following outcomes:
- which presidential nominee will win his or her party's primary, the general election popular vote, and the Electoral College;
- who will be the major party nominees for Vice President; and
- which party will control the next Congress.

The proposed submarket for economic indicator contracts will include winner-take-all contracts to predict monetary policy decisions of the Federal Open Market Committee regarding the federal funds target rate. The University represents that it will not list any economic indicator contract that would compete with any contract that is listed by a CFTC-regulated contract market, and the University would not list more than five economic indicator contracts at any one

2

time. Participation in the submarket for economic indicator contracts would be limited to students, faculty and staff at any participating universities.[3]

By design, the University's model for its proposed market for event contracts bears many close similarities to the IEM model, including the following items:

- The University's key employees overseeing the project will be three University professors and one administrator.
- Neither the professors nor the administrator will receive any compensation or other payment, directly or indirectly, for operating the market.
- Neither the University nor any of the key personnel operating the proposed market is required to register with the Commission, nor is any of these persons or entities a business affiliate of any person required to register with the Commission.
- There will be no additional fees other than those necessary to cover the basic expenses of running the market, including the cost of credit card processing of deposits and withdrawals, fulfillment of the know-your-customer ("KYC") process,[4] and all other associated regulatory compliance and operating costs.
- Participants will execute their own trades, no brokerage service will be available or allowed, and no commissions will be charged.

However, the University's proposed market for event contracts would feature certain aspects that would distinguish it from the IEM model. The following four departures from the IEM model, you argue, would cause the University's market for event contracts to produce more accurate results, thereby furthering the educational public interest purpose of the project, by permitting:

(1) a larger allowable number of traders in each contract;
(2) a larger number of traders that are not affiliated with the University to trade political event contracts;
(3) a larger allowable investment by any single market participant; and
(4) a limited level of advertising.

1. Number of traders in each contract

Participation in IEM is limited to 2000 total traders in any particular election for which a political market is operated, and to 1000 total trades in any particular economic indicator submarket. The University proposes to have a limit of 5000 total traders in any particular contract, explaining that broader participation would make these contracts more efficient and effective prediction tools. The University anticipates that the higher proposed cap on participation, coupled with a higher maximum deposit limit (discussed below), would together

---

[3] The University represents that several U.S. universities have indicated a willingness to participate in the University's market for event contracts. Thus far, the University has neither sought nor obtained firm commitments from any of the universities contacted and does not intend to do so until it obtains the necessary relief from Commission staff. Such participation by other universities, as planned, would be similar to the participation by several universities in the IEM that the University of Iowa has been able to obtain.

[4] The University represents that it will implement an age and identity verification system as part of a KYC process, performed by an outside independent party: Aristotle International, Inc.

increase the value of the academic research generated by the project by reducing the likelihood of thinly-traded contracts. Thinly-traded contracts, the University explains, would likely allow individual users to have an outsized impact on contracts, thereby creating the potential for artificially skewed results and undermining the academic utility of the project.

2. Access to submarket for political event contracts

IEM limits participation in its political submarket to primarily students, faculty and staff at participating universities, and restricts participation in its economic indicator submarket to only such "academic traders." While the University proposes that participation in its economic indicator submarket be restricted to only academic traders at participating universities, the University has also proposed that trading in its political submarket not be limited to primarily academic traders. In support of its proposal, the University posits that many of the same reasons stated above for expanding the maximum number of allowable traders would also logically apply to this issue — a reduced number of traders would bias the market and reduce access to a broader range of informational sources, thereby reducing accuracy and academic utility.

3. Larger allowable investment by any single market participant

IEM limits the maximum investment by any single participant in any particular contract to $500. The University proposes raising the limit on investment by any single participant in any particular contract to $850. The University represents that, using the Consumer Price Index, $500 in 1992 (the year in which the Division first granted no-action relief to the University of Iowa) had the same buying power as $844.99 in 2014. The University explains that increasing the maximum allowable investment would allow participants the ability to participate in several more contracts than they might otherwise if limited to 1992 dollar levels. This, the University explains, would make its market more efficient by minimizing the likelihood of thinly-traded contracts, while still adhering to the small-dollar, educational purpose of the IEM model.

4. Advertising would be permitted

In its 1993 relief request, IEM represented that none of its operators, nor any other person involved with the IEM, engages in any advertising concerning the IEM. The University proposes to engage in limited advertisement of its market in media outlets where there is a high likelihood of reaching those interested in the subject matter of its contracts. Any such advertisements would prominently disclose that the proposed market is unregulated, experimental, and being operated for academic purposes. It is the University's view that limited advertisement is necessary to attract sufficient and diverse users to its proposed market.

The University represents that it will use little, if any, paid advertisements to market its contracts. Instead, the University would attract participants through channels of communication within the academic community, including word-of-mouth marketing, articles and interviews with media.

DMO notes that the University's proposed political event contracts can be distinguished from the North American Derivatives Exchange's ("Nadex") political event contracts that were

4

disapproved by Commission Order on April 2, 2012.[5] Specifically, the University's request for no-action relief was not in any way premised upon claims that its proposed event contracts have any hedging or price-basing utility. Much to the contrary, the University's proposed market for event contracts represents an academic exercise demonstrating the information gathering and predictive capabilities of markets. Another important distinction is that the University's proposed market would operate on a non-profit basis. Furthermore, because participation levels and maximum allowable investments in the University's proposed contracts would each be capped at very low levels, the University's proposed political event contracts would not have the same potential for compromising the integrity of elections as would Nadex's disapproved political event contracts, which were much larger.

II. Scope of no-action relief provided by DMO

Based upon your representations concerning the purposes and manner of operation of your proposed market for event contracts, the Division does not believe that operation of this proposed market without registration as a DCM, FBOT, or swap execution facility ("SEF"),[6] or without registration of its operators, would be contrary to the public interest. The Division's conclusion is based upon the facts that, among others, your proposed market for event contracts has been designed to serve academic purposes and the operators will receive no compensation. Furthermore, the Division would allow the University's four proposed variations from the IEM model, as discussed above, because each is intended to produce more accurate results, which would promote the educational public interest purpose of the project while maintaining the small-scale, not-for profit nature of the proposed market.

Consequently, based upon your representations, DMO will not recommend that the Commission take any enforcement action in connection with the operation of your proposed market for event contracts based upon the operators' not seeking designation as a contract market, registering under the Act or otherwise complying with the Act or Commission regulations.

DMO does not render any opinion as to whether the operation of your proposed market for event contracts violates any state law provisions, nor does the Division's position excuse non-compliance with any such law.

This letter is based upon the information that has been provided to the Division and is subject to the conditions stated above. Any different, changed or omitted material facts or circumstances may render this no-action relief void.

This letter, and the no-action position taken herein, represents the views of DMO only, and does not necessarily represent the positions or views of the Commission or of any other division or

---

[5] *Order Prohibiting the Listing or Trading of Political Event Contracts* (April 2, 2012), *available at* http://www.cftc.gov/ucm/groups/public/@rulesandproducts/documents/ifdocs/nadexorder040212.pdf.   The disapproved Nadex contracts were binary option contracts that would have paid out based upon the results of various U.S. federal elections in 2012.

[6] DMO staff believes that the proposed event contracts could be characterized as swaps pursuant to CEA section 1a(47)(A)(ii). In general, no person may operate a facility for the trading or processing of swaps unless the facility is registered as a SEF or as a DCM. *See* CEA section 5h(a)(1).

office of the Commission. As with all no-action letters, DMO retains the authority to condition further, modify, suspend, terminate or otherwise restrict the terms of the no-action relief provided herein, in its discretion.

If you have any questions concerning this correspondence, please contact David Van Wagner, Chief Counsel, Division of Market Oversight, at (202) 418-5481 or dvanwagner@cftc.gov, or David Pepper, Attorney Advisor, Division of Market Oversight, at (202) 418-5565 or dpepper@cftc.gov.

Sincerely,

_____

Vincent McGonagle
Director, Division of Market Oversight

6

Exhibit 3

U.S. COMMODITY FUTURES TRADING COMMISSION

Three Lafayette Centre
1155 21st Street, NW, Washington, DC 20581
Telephone: (202) 418-5000

Division of
Market Oversight

Vincent McGonagle
Director

Professor Margaret Hyland, Ph.D.
Vice-Provost (Research)
Vice Chancellor's Office
Victoria University of Wellington
HU 207, Hunter Building, Gate 1
Kelburn Parade, Kelburn
Wellington 6012, New Zealand

Re: Withdrawal of CFTC Letter No. 14-130

Dear Dr. Hyland:

As you are aware, on October 29, 2014, the Division of Market Oversight ("DMO" or "Division") of the Commodity Futures Trading Commission ("CFTC" or "Commission") issued CFTC Letter No. 14-130 ("Letter 14-130" or "Letter") granting the request of Victoria University of Wellington, New Zealand ("the University") that the Division not recommend enforcement action (*i.e.*, "no-action" relief) against the University in connection with its operation of an online, not-for-profit, event contract market in the U.S. for educational and research purposes, without registration as a designated contract market, swap execution facility, or foreign board of trade, and without registration of its operators, subject to certain terms outlined in the Letter.[1]

According to the terms of the Letter, DMO granted the relief based upon the representations of the University that the proposed event contract market would:

(1) be small-scale and not-for-profit;
(2) be operated for academic and research purposes only;
(3) be overseen by faculty at the University, without receipt of separate compensation;
(4) offer event contracts consisting of two submarkets for binary option contracts concerning political election outcomes and economic indicators;

---

[1] Letter 14-130, https://www.cftc.gov/sites/default/files/idc/groups/public/@lrlettergeneral/documents/letter/14-130.pdf.

(5) be limited to 5,000 traders per contract, with an $850 investment limit per participant in any contract;

(6) not offer brokerage services or charge commissions to participants;

(7) utilize a third-party service provider to perform know-your-customer ("KYC") due diligence on its participants[2];

(8) only charge those fees necessary to cover the fulfilment of the KYC process, regulatory compliance, and basic expenses to operate the proposed event contract market; and

(9) limit advertising to media outlets where there is a high likelihood of reaching those interested in the subject matter of its event contracts, provided that such advertising prominently discloses that the platform is unregulated, experimental, and being operated for academic purposes.[3]

The University has not operated its market in compliance with the terms of Letter 14-130.[4] As a result, Letter 14-130 is hereby withdrawn and, as such, is not available for the listing or operation of any new or related contracts. To the extent that the University is operating any contract market, as of the date of this letter, in a manner consistent with each of the terms and conditions provided in Letter 14-130, all of those related and remaining listed contracts and positions comprising all associated open interest in such market should be closed out and/or liquidated no later than 11:59 p.m. eastern on February 15, 2023.

Should you have any questions, please do not hesitate to contact Brigitte Weyls, Assistant Chief Counsel, Division of Market Oversight, bweyls@cftc.gov or 312-596-0547, or Rachel Kaplan Reicher, Senior Special Counsel to the Director, Division of Market Oversight, rreicher@cftc.gov or 202-418-6233.

Sincerely,

_____
Vincent McGonagle
Director
Division of Market Oversight

---

[2] *Id*. at 3.

[3] *Id*.

[4] In Letter 14-130, DMO stated that it "retains the authority to condition further, modify, suspend, terminate, or otherwise restrict the terms of the no-action relief provided herein, in its discretion." *See id*. at 6.

2

Exhibit 4

Mills, Charles

Subject: FW: Victoria University NAL Compliance

From: Waldman, Daniel R. <Dan.Waldman@arnoldporter.com>
Sent: Monday, November 24, 2014 11:55 AM
To: 'Van Wagner, David' <dvanwagner@CFTC.gov>
Cc: 'McGonagle, Vincent A.' <vmcgonagle@CFTC.gov>; 'Pepper, David N.' <DPepper@CFTC.gov>; 'Dolan, John'
<jdolan@CFTC.gov>
Subject: RE: Victoria University NAL Compliance

David:

Thank you for the heads up. I will let them know promptly. I will also emphasize to them the importance of everyone
involved familiarizing themselves with the terms of the no-action.

Best,

Dan

From: Van Wagner, David [mailto:dvanwagner@CFTC.gov]
Sent: Monday, November 24, 2014 11:49 AM
To: Waldman, Daniel R.
Cc: McGonagle, Vincent A.; Pepper, David N.; Dolan, John
Subject: Victoria University NAL Compliance

Dan,

I trust that you can pass along to Victoria University the following message.

Many CFTC personnel have received unsolicited invitations to participate in the Predict It
market (please see below). According to the "Terms and Conditions" link on Predict It's
website (https://www.predictit.com/Home/TermsAndConditions), the market is "owned and
operated by Victoria University of Wellington, New Zealand." The scale and nature of such
indiscriminate advertising appears to fall outside the bounds of the "limited advertising"
permitted by No-Action Letter 14-130. Similarly, certain listed contracts appear to fall outside
the scope of that same no-action relief.

NAL 14-130 lists three non-exclusive examples of political contracts – each is tied to election
outcomes. While the letter allows some flexibility with respect to political contracts, certain
contracts such as "how many ebola cases in the US in 2015" would appear to have no
relationship to elections or any other meaningful political question.

Victoria University personnel should review NAL 14-130 and promptly make any necessary
adjustments to comply with its relief conditions.

1

Regards,

David

David P. Van Wagner
Chief Counsel
Division of Market Oversight
Commodity Futures Trading Commission
1155 21st Street, NW | Washington, DC 20581 | Tel: 202.418.5481

Predict It

Will Obama act on immigration this year?

Over the next two days, President Obama plans to spell out his vision for immigration reform. An executive order from the president could directly impact 5 million undocumented immigrants. It could also dramatically escalate an already tense standoff with congressional Republicans, who may use their spending authority to try to stop what they see as a legislative end run. Speaker John Boehner has called any executive action taken before the end of the year "playing with fire."

So, how's it going to play out...

Will President Obama issue an executive order on immigration by the end of 2014?

PREDICT NOW!

Featured Predictions

2

Will the FCC reclassify internet access under Title II of the Telecom Act?

Will Mary Landrieu be defeated in the Louisiana Senate election?

Will the House of Representatives vote to impeach President Barack Obama?

Note: The PredictIt market is unregulated, experimental and being operated for academic purposes.

Congressional staff should keep in mind that the STOCK Act prohibits trading based on material, non-public information gained as a result of Congressional employment. If you have questions about applications of the STOCK Act or other ethics rules, please contact the House or Senate Ethics Committees.

© Predict It! All Rights Reserved.

3

28

**IN THE UNITED STATES DISTRICT COURT
FOR THE WESTERN DISTRICT OF TEXAS**

KEVIN CLARKE, in his individual capacity, TREVOR BOECKMANN, in his individual capacity, HARRY CRANE, in his individual capacity, CORWIN SMIDT, in his individual capacity, PREDICT IT, INC., a Delaware corporation, and ARISTOTLE INTERNATIONAL, INC., a Delaware corporation,
 	
       Plaintiffs,
 	
  v.
 	
COMMODITY FUTURES TRADING COMMISSION,
 	
       Defendant.
	Case No. 1:22-cv-00909

DECLARATION OF KEVIN A. CLARKE

Pursuant to 28 U.S.C. § 1746, I, Kevin A. Clarke, do hereby declare:

1.   My name is Kevin A. Clarke. I am a resident of Austin, Texas, where I am the owner of Clarke Mineral Estate and Geosciences, LLC, an Assistant Coach for the University of Texas at Austin's Policy Debate Team. I submit this declaration in support of Plaintiffs' Motion for a Preliminary Injunction.

2.   I have personal knowledge of the facts stated herein.

3.   I have traded on the PredictIt Market for two years. At the time I began trading on the PredictIt Market, I investigated the Market's operations and discovered that the Market is operated pursuant to CFTC Letter No. 14-130 (the "No-Action Relief"), which I understand permitted the PredictIt Market to operate without formally registering as an exchange with the

29

CFTC. Knowing that the CFTC had signed off on the PredictIt Market's operations assured me of the security of my investments on the Market.

4.   I currently have approximately $11,000 invested in all 85 contract markets currently hosted on the PredictIt Market. Of those markets, approximately 14% of them will not settle on or before February 15, 2023.

5.   Based on my research and experience investing in political event contracts, I believe that my contracts predict the correct outcome of the political events to which they relate.

6.   I am aware that the CFTC revoked the No-Action Relief in CFTC Letter 22-08, entitled "Withdrawal of CFTC Letter No. 14-130" (the "Revocation"). The Revocation has had a direct and immediate impact on the value of PredictIt Market event contracts.

7.   Experienced PredictIt traders tend to purchase event contracts far in advance of the deciding event when the contracts' values are relatively low due to outcome uncertainty based on the event's remoteness. Only when the deciding event grows closer in time do those event contracts appreciate. Accordingly, the further in advance a trader purchases an event contract, the greater his financial gain is likely to be when he sells the contract at an appreciated value or the event closes in his favor. Using this strategy, I have made investments in event contracts predicting the outcome of the 2024 presidential election that I expect to appreciate significantly if allowed to run their course. These contracts will not settle before the February 15, 2023, when the CFTC has ordered that all outstanding PredictIt Market contracts be liquidated. Because of the CFTC's decision, forcing the early liquidation of my contracts, I will lose the opportunity to see these contracts to the end and the gains I anticipate in doing so, or in trading those contracts away at advantageous prices before their maturation.

8.   I know of no rationale for why the CFTC has chosen February 15, 2023, as the cutoff date for the PredictIt Market's operations. But the imposition of this seemingly arbitrary date has significantly distorted the current and prospective value of 2024 election contracts because trades are now attempting to salvage their investments based on factors other than the correct outcome of the 2024 presidential election. As a result, I am feeling the effects of the revocation right now, as the market is not working efficiently, is distorted, and I cannot trade the contracts with others attempt the predict *what the outcome of the contract will be* as opposed as to some effort to just get what they can from a difficult situation created by the CFTC.

9.   Based on what I know about the markets, if the CFTC is enjoined from requiring contracts to end prematurely in February 2023 and the contracts are allowed to run their natural course, the most significant distortions in the Market should end, as participants resume attempting to predict the post-February 2023 outcome of the event on which the contract turns. Active traders can then resume selling their contracts at times where they believe the price overstates the probability of the outcome and buying when they believe the price understates the probability of the outcome.
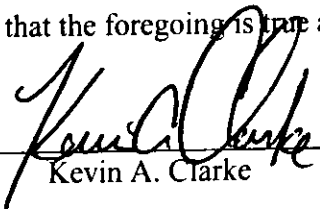
10.   Not only am I a Market participant, I am also informed consumer of the data the Market provides in terms of projecting the outcome of elections and other significant political events. I have great faith in the superior accuracy of PredictIt Market pricing in making political projections over polls and punditry. This confidence comes from what I observe of other traders in the community, who participate in online communities to discuss the reasoning behind their positions. Because of the modest financial investments in stake, I analyze, and I see other traders analyzing, up-to-the-date developments that will affect the outcome, doing incisive research on legal outcomes or effects of similar events in previous elections. What I rarely see is passionate

argument driven by bias or preference for an outcome, which can affect other forms of political projection. With the CFTC's crash-out date of February 2023, the data produced by the PredictIt Market is being stripped of its value for these longer-term contracts, with no immediately available replacement. The data created by the Market was of great interest and value to me as an observer of politics and, frankly, as a citizen acutely interested in the outcome of elections and other significant political events.

11.   The Revocation has also disrupted contract markets based on events that will occur before February 15, 2023, because it provides no certainty regarding which contract markets may continue to operate until February 15, 2023, and which must liquidate immediately due to noncompliance with the terms and conditions of the No-Action Relief decision. This uncertainty has led many traders to attempt to pull their money out of the Market immediately even if they could otherwise have profited from their contract investments. This withdrawal from the Market effects remaining traders' ability to sell appreciated contracts that they no longer believe predict the correct event outcome.

I declare under penalty of perjury that the foregoing is true and correct.

Executed on 9/27/2022   _____
                                                    Kevin A. Clarke

IN THE UNITED STATES DISTRICT COURT
FOR THE WESTERN DISTRICT OF TEXAS

KEVIN CLARKE, in his individual capacity, TREVOR BOECKMANN, in his individual capacity, HARRY CRANE, in his individual capacity, CORWIN SMIDT, in his individual capacity, PREDICT IT, INC., a Delaware corporation, and ARISTOTLE INTERNATIONAL, INC., a Delaware corporation,
 	
                    Plaintiffs,
 	
      v.
 	
COMMODITY FUTURES TRADING COMMISSION,
 	
                    Defendant.
	Case No. 1:22-cv-00909

DECLARATION OF TREVOR BOECKMANN

Pursuant to 28 U.S.C. § 1746, I, Trevor Boeckmann, do hereby declare:

1.   My name is Trevor Boeckmann. I am a resident of Manhattan in New York City, New York, where I am a public defender with the Neighborhood Defender Service of Harlem. I submit this declaration in support of Plaintiffs' Motion for a Preliminary Injunction.

2.   I have personal knowledge of the facts stated herein.

3.   I have traded on the PredictIt Market (the "Market") since 2016 and currently have approximately $24,000 invested on the PredictIt Market in various contract markets.

4.   Among the PredictIt event contracts that I have invested in are several related to the outcome of the 2024 presidential elections. For example, I currently own event contracts predicting who will be the Republican presidential nominee and which political party's candidate will win the 2024 presidential election.

5.   Based on my research and experience trading on the PredictIt Market, I believe the contracts I have purchased will produce a profit, either because they later may be sold at a higher value or because they predict the correct event outcome and will be redeemable for a dollar when that event occurs.

6.   I am aware that on August 4, 2022, the CFTC issued CFTC Letter No. 22-08, entitled "Withdrawal of CFTC Letter No. 14-130" (the "Revocation"), which I understand revokes a no-action relief letter previously issued by the CFTC that allowed the PredictIt Market to operate without registering as a designated contract market with the CFTC.

7.   I understand the Revocation to require the PredictIt Market to close or liquidate all event contracts currently offered on the Market, either immediately or by February 15, 2023. I do not understand why the CFTC will not allow existing contract markets to continue operating until their natural conclusions given the uncertainty premature liquidation has wrought.

8.   I have already observed changes caused by the Revocation in the pricing of my positions, likely due to traders' attempts to salvage their investment by withdrawing their assets from the Market or attempting to predict public sentiment related to the outcome of a political event on February 15, 2023, rather than what the outcome will actually be. These changes have undermined my trading strategy, which is predicated on the expectation that traders are investing in event contracts based, at least in part, on what the actual outcome of the event will be.

9.   My inability to see contracts through to their natural conclusion, and the distortion of the markets today, are causing me harm now. I think I am right about the projections represented by my investments and that, absent some artificial and premature liquidation date, their value will appreciate. I am losing the opportunity to realize that profit.   Also, I do not have an efficient market to see these contracts into now, even if I wanted to liquidate, because traders

are no longer focusing on the likely outcome of the 2024 elections but instead are just trying to get out for as little loss as they can as quickly as they can. My ability to realize the profit I believed my positions represented prior to the CFTC action and to exchange my contracts with other traders focused on *bona fide* predictions of the outcomes of the 2024 elections, for example, would be restored if the CFTC were ordered not to require a February 2023 end to my current contracts.

10.   Furthermore, it is unclear which of the contract markets I have invested in must terminate immediately and which may continue until February 15, 2023. It is also unclear how existing contracts—like the 2024-presidential-election contracts I have invested in—will or should be valued if forced to terminate before their deciding events occur. Regardless of how prematurely terminated event contracts are paid out, I will not realize my expected return on contracts that will not close before February 15, 2022, because they will be liquidated before their deciding event occurs at which point they could have been redeemed for one dollar each.

I declare under penalty of perjury that the foregoing is true and correct.

Executed on September 28, 2022

_____
Trevor Boeckmann

**IN THE UNITED STATES DISTRICT COURT
FOR THE WESTERN DISTRICT OF TEXAS**

KEVIN CLARKE, in his individual capacity, TREVOR BOECKMANN, in his individual capacity, HARRY CRANE, in his individual capacity, CORWIN SMIDT, in his individual capacity, PREDICT IT, INC., a Delaware corporation, and ARISTOTLE INTERNATIONAL, INC., a Delaware corporation,
 	
     Plaintiffs,
 	
     v.
 	
COMMODITY FUTURES TRADING COMMISSION,
 	
     Defendant.
	Case No. 2022-cv-00909

DECLARATION OF HARRY CRANE

Pursuant to 28 U.S.C. § 1746, I, Harry Crane, do hereby declare:

1.   My name is Harry Crane. I am a statistics professor at Rutgers University and a fellow at the London Mathematical Institute. I submit this declaration in support of Plaintiffs' Motion for a Preliminary Injunction.

2.   I have personal knowledge of the facts stated in this declaration.

3.   I have used the PredictIt Market and the data it generates in my teaching and research.

4.   In my research, I have used PredictIt Market data to analyze the reliability of various methods for forecasting future political outcomes. My analysis of PredictIt Market data generated between 2018 and 2020 suggests that the Market's percentage-trading price provides a more accurate prediction of election outcomes than analytics-based forecasts on the website

FiveThirtyEight. *See*, *e.g.*, Harry Crane and Darion Vinson, *Models v. Markets: Forecasting the 2020 U.S. Election*, RESEARCHERS.ONE (Jan. 3, 2021) (attached hereto as Exhibit 1).   In general, I have concluded that the PredictIt Market is a reliable resource for gaining insight into future election outcomes. In particular, the PredictIt Market is especially valuable for quantifying the impact of specific events (*e.g.*, poll releases or news stories) on the probabilities of particular outcomes. As such, they are a valuable source of real-time information about the status of a race.

5.   The PredictIt Market serves as a valuable check on accusations of media bias, poll manipulation, and election interference. The PredictIt Market helps bring nuance to such concerns. Shutting down the PredictIt Market will thus remove this resource, which is very much in the public interest.

6.   I do not agree with some critics who claim the PredictIt Market is ripe for manipulation and profiteering. My research has found no evidence of such manipulation. Until evidence of such manipulation can be concretely provided, any such claim is mere speculation.

7.   I have also used the PredictIt Market in my undergraduate course, Statistics, Science, and Society, for honors undergraduate students. The goal of the course is to teach students to think quantitatively about reporting and real-world occurrences. PredictIt is a valuable resource for demonstrating the discrepancy between trader opinion and media reports.

8.   I understand that the CFTC has revoked CFTC Letter No. 14-130, which allowed the PredictIt Market to operate without complying with certain laws and CFTC regulations that are potentially applicable to the Market. In effect, I understand that all contracts must be closed or liquidated by February 15, 2023.

9.   As a researcher, the 2024 election markets would be of principal interest. However, the CFTC requirement that contract markets are closed by February 15, 2023 distorts

these markets, as trading behavior is now adversely impacted by traders who are liquidating positions due to the influx of uncertainty over the CFTC action.

10.   The PredictIt Market's closure will negatively impact the academic community from both a research and pedagogical perspective. If not for the Market's closure, I plan to continue to use the PredictIt Market and its data in my teaching and research.

Executed on September 27, 2022   _/s/ Harry Crane_____
                                          Harry Crane

Exhibit 1

RES3ARCHERS.ONE

Models vs. Markets:
Forecasting the 2020 U.S. election

Harry Crane* and Darrion Vinson†

January 3, 2021

Abstract

We propose a market-based scoring (MBS) method for evaluating the performance of probabilistic forecasts. We demonstrate our approach on the 2020 U.S. elections for President, Senate and House of Representatives by evaluating the forecasts posted on the FiveThirtyEight website based on their performance against the prediction markets at PredictIt.

Our analysis finds that PredictIt and FiveThirtyEight perform comparably based on traditional metrics such as calibration and accuracy. For market-based scoring, we find that if we ignore PredictIt's fees and commissions, then FiveThirtyEight forecasts beat the markets overall; but if we factor in fees and commissions, the markets beat FiveThirtyEight. We discuss implications of this analysis for forecasting future election cycles and for betting market design and operations.

In addition to the analysis presented here, a running tally of results from the above analysis was updated and reported throughout the 2020 campaign at

https://pivs538.herokuapp.com/.

Comment: The first version of this article was posted to Researchers.One on October 26, 2020, 1 week before the 2020 U.S. election. That first version serves as a pre-registration of our proposed method before the election outcome was determined. All analysis performed below is based on the pre-registered methods proposed in the first version.

1   Introduction

The 2016 United Kingdom European Union membership referendum ("Brexit") and United States election of Donald Trump ("Trump") are two recent elections in which the vote outcome went against conventional wisdom of the likely outcome prior to the election. Both also had consequences beyond the countries in which they took place, as Brexit and Trump led to substantial changes in foreign policy and international trade that affected people and companies around the world. Though the headline result of the 2020 U.S. election—a Biden victory—agreed with the high-level assessment of polls and forecasters, the polls were once again skewed disproportionately against Trump and Republicans, leading to surprise outcomes in both House and Senate; see Figure 1.

---

*Rutgers University, Department of Statistics and Biostatistics
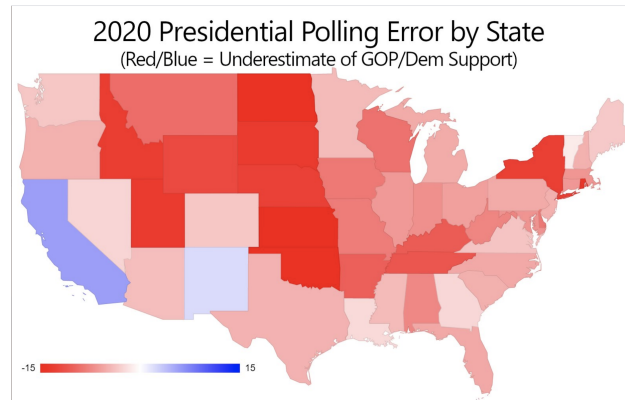†Columbia University

RES3ARCHERS.ONE

Figure 1: Plot of Electoral College polling errors in 2020 U.S. Presidential Election. Darker red/blue indicates a larger underestimate of republican/democratic support in each state. Source: Flip Pidot, American Civics Exchange.

Perhaps even more than the stark examples of Trump and Brexit, the confusion resulting from the fallout of the 2020 election highlights the significance of political forecasts, not just as entertaining horse race-like projections but as an important part of public discourse. The potential consequences of elections in globalized countries, such as United States, Britain and European nations, increases the need for reliable methods of electoral forecasting in the days, weeks and months preceding the vote. Reliable forecasts not only afford citizens a sense of what to anticipate but also allow financial institutions and governments to better prepare for anticipated changes in the event of a particular outcome. Unreliable forecasts, on the other hand, can sow doubts about the legitimacy of the electoral process and disenfranchise voters, as was the case for the 2020 U.S. election.

From the standpoint of forecasting, both Brexit and Trump were surprise outcomes, with both professional forecasters and betting markets projecting greater than 70%—and in many cases greater than 90%—that Britain would vote to Remain and the U.S. would elect Hilary Clinton. It's the nature of forecasting that the future cannot be predicted perfectly, but the occurrence of Brexit and Trump in close succession raised questions about the extent to which forecasters and betting markets are accurately processing the available information, and moreover which of the two is more efficient in doing so. The polling errors of 2020 have reenforced these questions. Were the Brexit, Trump and 2020 forecasts hindered by inaccurate data (e.g., polling bias) or personal bias of the forecasters, or were they mere statistical anomalies? Are statistical forecasts or betting markets a more reliable indicator of electoral outcomes? To answer the last question, what is the best way to evaluate the reliability of forecasts?

1.1   Models vs. Markets

To study the latter two questions, we compare two different approaches to election forecasting: those based on statistical modeling and data analysis ("Models") and those that rely on prediction markets to aggregate information and arrive at stable prices ("Markets"). We assess both approaches based on their relative performance in the 2020 U.S. Presidential and Congressional (House and Senate) elections.

To make this comparison, we propose the method of *Market-Based Scoring* (MBS), which evaluates forecasters based on how well an investor would perform if he were to

2

invest in a prediction market based on Model forecasts. A precursor to this approach was originally proposed in [5] for the 2018 U.S. midterm elections, and similar market-based metrics have also been suggested in [10, 11]. The rationale underlying the MBS approach is based on the correspondence between market prices and implied probabilities. Roughly, if the market price offers positive expected value relative to the forecasted probability, the investor buys; if the market price offers negative expected value relative to the forecasted probability, the investor sells any shares he owns. Once the decision to buy or sell is determined, the investor must determine how many shares to buy or sell. For this, market-based scoring requires a well-defined strategy for buying and selling. For the analysis given here, we consider two specific strategies based on the Kelly Criterion (KC) and Dollar Cost Averaging (DCA). Other strategies could be considered, but we have chosen KC and DCA for their simplicity and similarity to common strategies used in advantage gambling and professional investing. We also note that these two strategies and the accompanying analysis were pre-registered before the election.

We explain the details of our approach in Section 4 and summarize our analysis in Section 5. In Section 3 we discuss several benefits of the proposed market-based evaluation over traditional statistical metrics based on calibration and proper scoring rules. From our perspective, the main benefits of MBS are (i) it allows dynamic forecasts to be compared for the entire time series of forecasts and (ii) it provides a credible baseline comparison for evaluating model-based forecasts. We discuss these benefits along with other considerations in Section 3. We discuss how our analysis and proposed methods fit into the broader scope of forecast evaluation and public dissemination of forecasts in Section 6.

In addition to the analysis presented here, a running tally of results from the above analysis was updated and reported throughout the 2020 campaign at

https://pivs538.herokuapp.com/.

The interactive app compares Models and Markets based according to the above market-based scoring criteria.

1.2   A Tale of Two Narratives

In the 2020 election, the wide discrepancy between Models and Markets was explained by two conflicting narratives. The "pro-Models" narrative argued that Markets are distorted by irrational traders, especially by a disproportionate representation of republican or conservative support among active traders, thereby artificially inflating prices on Trump. The "pro-Markets" narrative argued that Markets were pricing in the likelihood of a widespread polling error of the kind observed in 2016 and eventually also in 2020 (see Figure 1), while the Models were based on the assumption that the pollsters have corrected for 2016 mistakes. Post-election, the pro-Markets narrative was vindicated, in part by Figure 1, but the possibility of conservative bias in Markets also gained support as a result of Markets' persistent pricing of Trump in the 10-15% range several weeks after the media declared the election for Biden. On the one hand, the Markets' relative skew toward Trump (while still making Biden the favorite) can be explained as pricing in a polling error of the kind we observed, but the anomalous Market behavior after the election raises the question of whether the Markets were over-correcting for polling error, perhaps due to trader bias. In addition to presenting a new methodology that can be applied to forecasting other events, we hope to shed light on the accuracy of 2020 election forecasts in our analysis below.

RES3ARCHERS.ONE

2   Overview: Models vs. Markets

We compare forecasts from FiveThirtyEight[1] (538) and market prices on PredictIt[2] (PI) for the 2020 U.S. President, Senate and House races. For simplicity, we do not consider forecasts of other outlets or prices on other markets, such as IEM or Betfair, but the same analysis could be carried out for any of these outlets given forecast and market data at sufficient frequencies (e.g., daily or weekly).

In the months before the election, an empirical comparison of the 538 forecast and PI market prices reveals systematic discrepancies. At the Presidential level, 538 consistently evaluated Biden's chances approximately 20 percentage points higher than PI. As of October 23, for example, the PI market for President had 'Yes' shares of Biden and Trump trading at \$0.63 and \$0.41, respectively, for an implied probability forecast of 60.5% for Biden and 39.5% for Trump.[3] FiveThirtyEight, by contrast, forecasted 87% for Biden and 12% for Trump.[4]. The discrepancy for Senate majority was less dramatic but still significant, with PI prices implying a probability of 61.0% for Democratic control of the Senate[5] and 538 forecasting a 74% probability. FiveThirtyEight assessed the probability that Democrats would win 225 or more seats in the House of Representatives at about 90%. The latest tally, with two seats still undecided, gives Democrats just 222 seats.

The above discrepancy was consistent across other forecasters and other betting markets: for the most part, forecasters assessed Biden's chance of winning in the range of 85-95%, while the betting markets assessed it in the 60-70% range. Such a pronounced and systematic divergence raises the question of which of the two is more reliable. Are the markets pricing in different information than the forecasters, or are the markets distorted by structural flaws and irrational traders?

It is among the goals of our analysis to shed some light on the above question. And while our conclusions cannot definitively identify the root cause of the discrepancy, we believe that they do provide some insights that will help avoid confusion in future election cycles.

While there are known sources of potential error in both prediction market prices and statistical forecasts—prediction markets are distorted by transaction costs and trader irrationality [12], and statistical forecasts are limited by model misspecification and data quality—the large differences observed above cannot simply be accounted for by high transaction costs or other known sources of model or market inefficiency. For example, the above difference between 538 and PI on the Presidential winner corresponds to a 38.1% overlay on Biden; that is, a purchase of 1 share of Biden at 0.63 has an expected profit of

$$0.37 \times 0.87 - 0.63 \times 0.13 = 0.24$$

on an investment of 0.63, a profitable opportunity even in light of PredictIt's high 10% commission on winning contracts and 5% withdrawal fee.

---

[1]http://www.fivethirtyeight.com

[2]http://www.predictit.org

[3]https://www.predictit.org/markets/detail/3698/Who-will-win-the-2020-US-presidential-election

[4]https://projects.fivethirtyeight.com/2020-election-forecast/

[5]https://www.predictit.org/markets/detail/4366/Which-party-will-control-the-Senate-after-2020-election

4

RES3ARCHERS.ONE

2.1   Models

The *Models* approach to election forecasting uses statistical methods to aggregate polling information and other macro-level electoral data in order to overcome the noise present in individual polls. Models became popular after 538 was reported to have correctly predicted 49 and 50 states correctly in the 2008 and 2012 Presidential elections, respectively. Since then a number of media outlets, including the Economist, New York Times and Huffington Post, and research groups, such as Princeton Election Consortium, have publicized their own model-based forecasts in advance of major elections.

Pre-election polls have long sought to mitigate uncertainty about voter sentiment by surveying would-be voters about their preferences. Political polling faces numerous practical challenges in how to conduct surveys to avoid systematic bias in results. There is now a well-developed statistical theory for handling these challenges, which allows pollsters to both estimate the amount of support for each issue and calculate the margin of error for those estimates. But there are still questions about the efficacy of polling. After Brexit and Trump additional doubts have been raised about the effectiveness of polling, especially on polarizing and sensitive issues. Last minute changes to voter sentiment, voter reluctance to respond honestly to polls (so-called "silent Trump" voters [8]) and voter turnout are just a few sources of inaccuracy in addition to ordinary statistical error. For the 2020 cycle, there was additional uncertainty and potential biases in polls caused by the Covid-19 pandemic and changes to the way elections were conducted in many states.

Similar to the Trump and Brexit polling errors in 2016, polls in the 2020 U.S. election systematically underestimated support for Trump. Figure 1 shows that polls underestimated support for the Republican candidate in 48 of 50 states during the 2020 election cycle. For the 2020 U.S. Presidential election, for example, RealClearPolitics (RCP) recorded 14 polls taken between October 1 and October 22 in the swing state of Florida, with results ranging from 50%-46% in favor of Trump (Trump +4) to 51%-40% in favor of Biden (Biden +11). The final RCP average of polls assessed Biden's advantage of 47.9%-47.0% (Biden +0.9), while the actual result in Florida was 51.2%-47.9% in favor of Trump (Trump +3.3). As Figure 1 shows, a similar skew of polls was observed in 48 of 50 states.

These initial observations provide empirical evidence of systematic polling bias. As polls are one of the main inputs to data-based forecasts at FiveThirtyEight, NY Times, The Economist and other outlets, questions arise about potential biases in their forecasts. For example, FiveThirtyEight's final projection in Florida gave Biden a 69%-31% advantage over Trump. It is claimed that model-based approaches, such as those designed by 538, distill the conflicting information in these polls into a single forecast, thereby correcting for biases of the kind seen above. But without a systematic approach to evaluating diverging poll results, accounting for potential biases and correlations among them, and also adjusting for changes in voter sentiment over the duration of time during which the polls were taken, it's unclear what forecasts based on these polls tell us.

Limitations of Models   For the most part, model-based methods are limited to using information that can be handled by existing techniques in data analysis. Statistical models are best equipped to process information contained in polls and other data on voter sentiment, such as economic indicators, employment statistics, etc. They are, however, limited by the quality and accuracy of that data. Most notably, polls can be inaccurate

because of both statistical error as well as anomalies in the electorate that motivate some voters to refuse to participate or to misrepresent their views, e.g., so-called "silent Trump" voters in 2016 [8]. Beyond issues of data quality, model-based methods are limited by the quality of their own methods, and in particular are subject to model misspecification and personal biases of the statisticians performing the analysis.

2.2   Markets

Political prediction markets, such as IEM and PI, exist primarily as research tools for studying the efficacy of event-based markets for aggregating information and providing insight into uncertain future outcomes. Other markets, such as the Betfair betting exchange and election offerings at sportsbooks, exist for the primary purpose of gambling, but may also provide similar insights due to market forces. In the years since IEM and PI have been introduced, academic research has focused mostly on market efficiency and the presence of arbitrage; see [14] and references therein.

The *Markets* approach seeks to leverage markets' ability to arrive at a stable price by aggregating information across market participants. Proponents of markets argue for their ability to synthesize available information (public and private, quantitative and qualitative) into the market price. The fact that market participants are risking real money provides a clear incentive for price accuracy. Because investors do not benefit monetarily from betting on candidates with a low chance of winning, it is expected that market prices should produce a reliable forecast. In addition, if the market participants are behaving irrationally—for example, if market participants happen to be predominantly Republican voters and overestimate Trump's chance of winning as a result of personal bias—then opportunistic traders gain an advantage by purchasing shares on Biden, thus contributing to more accurate pricing. For example, a study of the betting market Betfair on the night of Brexit found that prices on Betfair responded more efficiently to information than financial markets, leaving a window of about one hour in which savy market participants could arbitrage between the two [2].

Limitations of Markets   Most prior studies of political prediction markets focus on their efficiency: how well do markets respond to new information and incorporate that information into their prices? The Auld–Linton study of market response to Brexit found that both Betfair and the financial markets were inefficient in responding to information, but the Betfair market was more efficient overall. Other studies on prediction markets identify several potential sources of inefficiency, including regulatory constraints [1], longshot biases [3, 9], and high transaction costs [3, 12, 16]; see [14] for a recent study comparing arbitrage opportunities between IEM and PI.

While the above observations provide support for market-based methods in principle, the effectiveness of prediction markets at accurate pricing depends on how well the market design promotes the desired outcomes. The prediction markets at IEM and PI, for example, operate under strong constraints on the number of participants and maximum exposure of each participant to a given contract. On IEM, for example, political markets are limited to a maximum 2000 participants, with each participant limited to a maximum investment of $500 per contract. PredictIt markets are limited to 5000 participants, with each participant limited to a maximum investment of $850 per contract. With a limited participant pool and a cap on the amount each participant can risk, pricing anomalies caused by systematic irrationality in favor of one of the candidates are not easily corrected

by market forces. Rational traders simply lack the purchasing power and the markets lack the liquidity necessary to crowd out such inefficiencies.

Beyond the above structural barriers, PI traders are subject to a 10% winner's commission (i.e., a commission of 10% of profits on all profitable trades) as well as a 5% withdrawal fee. The impact of these fees on market efficiency are apparent in the distorted prices of highly certain political outcomes. For example, on the morning of the 2020 election, shares of Biden to win California sold for $0.94 on PredictIt, even though all forecasts and reasonable assessments of the electorate suggested Biden to have greater than 99% chance of winning California. If we assume, for illustration, that Biden was 100% to win California, then the $0.94 price offered traders a sure return of about 6.4% on investment, in the absence of fees. However, if we account for PredictIt's 10% winning commission and 5% withdrawal fee, the return diminishes to 0.46%. When accounting for the fact that Biden's chance is less than 100% and the opportunity cost of using funds to invest in other, higher return markets, we find that severe price distortions are the result of trader's rational response to the market's structural defects.

3   Methodology

A common criticism of model-based forecasts reported by FiveThirtyEight and other news outlets is the lack of a well-defined criterion for evaluation, which leaves their performance open to interpretation, subject to punditry, and ripe for post hoc analysis. In an attempt to address these criticisms, FiveThirtyEight publishes a summary of its past performances relative to the statistical metrics of calibration (unbiasedness) and accuracy (closeness to the truth).[6] According to FiveThirtyEight's self-reporting, its political forecasts perform well on both metrics when compared to the forecasts of a so-called "unskilled forecaster". For context, we explain both metrics in this section and also discuss their limitations for evaluating forecast accuracy.

The limitations of calibration and accuracy cited below call for a better approach to forecast evaluation. For this purpose, we propose a new market-based scoring method for evaluating forecasts based on the link between probabilistic forecasts and pricing bets. Our method is motivated by the more general Fundamental Principle of Probability (FPP) [4], which is particularly well-suited to the comparison between Models and Markets. Markets, in particular, aim to extract a meaningful signal by requiring participants to "put their money where their mouth is" *before* the outcome happens, with a clearcut scoring system in terms of profit and loss. We discuss this method further in Section 4.

3.1   Calibration

Roughly, a forecast is calibrated if 10% of its 10% forecasts occur, 20% of its 20% forecasts occur, and so on. Formally, calibration is assessed by comparing the empirical frequencies with which forecasted outcomes occurred against the frequencies of an ideal calibrated forecaster.

To formalize, let $i = 1, \ldots, N$ index N distinct events to which a forecaster assigns probabilities $\mathbf{p} = \{p_i\}_{i=1,\ldots,N}$. Let $\mathbf{y} = \{y_i\}_{i=1,\ldots,N}$ record the outcome of each event, with $y_i = 1$ indicating that the ith event happened, and $y_i = 0$ indicating that it did not

---

[6]https://projects.fivethirtyeight.com/checking-our-work/

7

happen. For example, $i = 1$ may correspond to the event "Trump wins the statewide vote in Ohio", $i = 2$ may correspond to "Biden wins the statewide vote in Florida", and so on. (To be clear, note that the forecast p_i is made without knowledge of the outcome y_i.).

Calibration measures the long-run performance of the forecaster's empirical performance $\hat{F}(p)$ to the performance of a perfectly calibrated forecaster, whose forecasts of p occur with an exact frequency of p, i.e., $F(p) = p$. For illustration, suppose the forecaster assigns the following forecasts to a collection of 10 events, for which the following outcomes were observed.

i	1	2	3	4	5	6	7	8	9	10
p_i	0.5	0.5	0.5	0.5	0.5	0.5	0.2	0.2	0.2	0.2
y_i	1	1	0	0	1	1	1	0	0	0

In the above notation, the forecaster assigned the value 0.5 to events $i = 1, \ldots, 6$, of which 4 occurred. The forecasts have value $\hat{F}(0.5) = 4/6 \approx 0.67$. Similarly, the forecaster assigned 0.2 to events $i = 7, \ldots, 10$, of which 1 occurred, for a value of $\hat{F}(0.2) = 1/4 = 0.25$.

In the above illustration, all forecasts correspond to discrete values 0.2 or 0.5, but in practice, over a long series of events, there may be forecasts ranging from very close to 0 and very close to 1 at differing levels of decimal precision. For this, it is impractical to evaluate the performance of each forecast value in isolation. Intuitively, forecasts of 0.511 and 0.512 are similar enough that each contains information about the other. A 0.511 forecast may also contain some information about the performance of 0.657 forecasts (for example), but to a lesser extent.

To account for proximity of forecasts in this way, we smooth the forecasts using a kernel function $K(p, p')$, which quantifies how much a forecast of p' should be counted toward the performance of forecasts of p. Given a collection of forecasts $\mathbf{p} = \{p_i\}_{i=1,\ldots,N}$, outcomes $\mathbf{y} = \{y_i\}_{i=1,\ldots,N}$, and a kernel $K(p, p')$, we define

$$\hat{F}(p) = \frac{1}{N} \sum_{i=1}^{N} K(p, p_i)(y_i - p_i), \quad 0 \leq p \leq 1. \tag{1}$$

For a simple example, the naive kernel

$$K(p, p') = \begin{cases} 1, & p = p', \\ 0, & \text{otherwise,} \end{cases} \tag{2}$$

was used in the opening example of this section, where only forecasts of exactly p factor into the calibration of p events. But this is too fine-grained for practical purposes. For all or almost all values of p, any given forecaster will have forecasted at most 1 outcome to have probability p. To address this issue, it's natural to smooth out the weights assigned by K to share information among nearby forecasts (e.g., 50% and 51%). The natural next step beyond (2) is to aggregate all forecasts within some region of p by selecting a small value fo ϵ (e.g., $\epsilon = 0.02$) and putting

$$K(p, p') = \begin{cases} \epsilon^{-1}, & |p - p'| < \epsilon, \\ 0, & \text{otherwise,} \end{cases} \tag{3}$$

Though addressing the issue posed by (2), the kernel given in (3) has issues of its own, especially due to its sensitivity to the sharp cutoff at the arbitrarily chosen ϵ. We can

8

address this further by choosing a continuous kernel, which for a given p assigns some weight (however small) to all forecasts p'. Ideally, $K(p, p')$ should be decreasing in $|p - p'|$, so that as the forecast p' gets further from p, the contribution of p' to the forecaster's calibration at p becomes negligible. Thus, under such a kernel, both 1% and 49% forecasts affect the calibration at 50%, but the weight assigned to the latter overwhelms the former. Regardless of which kernel is used, calibration is a measure of unbiasedness, in the sense that when a calibrated forecaster states a probability of p, the associated outcome tends to occur with frequency p.

3.1.1   Caveats of calibration

At first glance, calibration seems a desirable property for probabilistic forecasts. At minimum, it aids the interpretability of a forecaster's output: when a forecaster puts a 40% probability on something, it can be expected to happen 40% of the time. But it's important to keep in mind that calibration is a property of the forecaster, not of the events being forecast. And while good forecasts tend to be calibrated, not all calibrated forecasts are good.

In fact, it is easy for a forecaster to be calibrated without doing any actual "forecasting". To see how, imagine forecasting the outcome of a horse race with 10 horses. Without any information about the horses in the race, we know that 1 horse will win and the other 9 will lose. So while we don't know which horse will win, we do know that exactly 1 out of 10 (or 10%) of the horses in the race will win. Assigning a uniform 1/10 probability to each horse guarantees calibration of our 10% forecasts, but isn't a good strategy for making money at the racetrack. The suggested forecasting strategy is guaranteed to be calibrated without any apparent forecasting expertise or insight into the outcome. Similarly, in a two-person political race, the naive strategy that assigns 50% to each candidate is guaranteed to be calibrated for 50% forecasts because, for each race, exactly 1 of the 2 candidates (50%) will win and the other will lose.

The above calibration strategy is a naive version of a more sophisticated strategy known as *defensive forecasting*. Just as in the above naive approach, the defensive forecaster assigns probabilities that guarantee long-run calibration without doing any actual "forecasting" [13]. In defensive forecasting, the forecaster iteratively corrects for past deviations from calibration, based only on past forecasts. In effect, the forecaster who knows how he is being evaluated can overcorrect for past deviations when making future forecasts by thinking of his forecasts as a repeated game against a bettor who makes money whenever the forecaster deviates from calibration. The forecaster's goal in this game is to prevent the bettor from making money, and he can set his forecasts to ensure that doesn't happen. The technical details of this approach are beyond the scope of this article, but the concept is important to bear in mind. We refer the reader to [13] for technical details on defensive forecasting, and [5] for an illustration in the setting of the 2018 election.

3.1.2   Calibration of Models and Markets in 2020

Calibration tables for 538 and PI for 2020 election are given in Tables 1 and 2. For each probability bin, we compute the number of outcomes expected based on the forecasts (column: N (exp)) and the number of times the outcome actually occurred under the given forecast (column: N (act)). These expected and actual counts give expected and

prob	N (exp)	N (act)	freq (exp)	freq (actual)	Z
0.00-0.05	1	0	0.007	0.000	-0.8
0.05-0.15	2	2	0.096	0.075	-0.3
0.15-0.30	3	2	0.208	0.133	-0.7
0.30-0.40	4	4	0.346	0.333	-0.1
0.40-0.60	17	17	0.500	0.500	-0.0
0.60-0.70	8	8	0.65	0.667	0.1
0.70-0.85	12	13	0.792	0.867	0.7
0.85-0.95	19	20	0.905	0.929	0.4
0.95-1.00	49	49	0.989	0.980	-0.6

Table 1: FiveThirtyEight Calibration table. Chi-square p-value: 0.99.

prob	N (exp)	N (act)	freq (exp)	freq (actual)	Z
0.00-0.05	1	0	0.032	0.000	-0.9
0.05-0.15	3	1	0.091	0.026	-1.4
0.15-0.30	3	2	0.246	0.154	-0.8
0.30-0.40	5	5	0.359	0.385	0.2
0.40-0.60	19	17	0.509	0.447	-0.8
0.60-0.70	11	10	0.658	0.588	-0.6
0.70-0.85	14	15	0.762	0.833	0.7
0.85-0.95	32	33	0.927	0.942	0.4
0.95-1.00	23	24	0.975	1.000	0.8

Table 2: PredictIt Calibration table. Chi-square p-value: 0.89

actual frequences (freq (exp) and freq (act), respectively). For each bin, the Z-score is computed according to the assumption that forecasts apply to independent events.

From each table, we perform a chi-square goodness of fit test to detect deviations from calibration. Based on this test, we find no evidence against calibration of either 538 or PredictIt.

3.2   Accuracy

Good forecasts should be accurate, meaning they tend to be close to the truth. The most accurate forecasts are perfect predictions—they assign probability 1 to events that happen and probability 0 to events that don't happen. The least accurate forecasts assign probability 1 to events that don't happen and probability 0 to events that do happen. Most forecasts lie somewhere in between, assigning an intermediate probability $0 < p < 1$ to each event.

To formally assess the accuracy of probabilistic forecasts, we define a *scoring rule* $\mathcal{S}(P, y)$, which can be thought of as the reward (or loss) that a forecaster with predictive distribution P receives (or incurs) when y occurs. Given $\mathcal{S}$, a series of forecasts, represented by a set of predictive distributions $\mathbf{P} = \{P_i\}_{i=1,\ldots,N}$, and outcomes $\mathbf{y} = \{y_i\}_{i=1,\ldots,N}$, is assigned a score

$$\mathcal{S}(\mathbf{P}, \mathbf{y}) = \frac{1}{N} \sum_{i=1}^{N} \mathcal{S}(P_i, y_i). \tag{4}$$

10

RES3ARCHERS.ONE

For assessing election forecasts, we specialize to binary outcomes, for which each outcome y_i either occurs ($y_i = 1$) or does not ($y_i = 0$). Writing p_i to denote the forecast of the outcome $y_i = 1$, and thus $1 - p_i$ for the forecast of $y_i = 0$, two common scoring rules are

$$\text{Brier} : \mathcal{S}_B(\mathbf{p}, \mathbf{y}) = -\frac{1}{N} \sum_i (p_i - y_i)^2 \quad \text{and}$$

$$\text{Logarithmic} : \mathcal{S}_{\log}(\mathbf{p}, \mathbf{y}) = \frac{1}{N} \sum_i y_i \log(p_i) + (1 - y_i) \log(1 - p_i),$$

where $\mathbf{p} = \{p_i\}_{i=1,\ldots,N}$ and $\mathbf{y} = \{y_i\}_{i=1,\ldots,N}$. Notice that both scores equal 0 when $y_i = p_i$, meaning that a probability of 1 was assigned to an event that happened ($y_i = 1$) or a probability of 0 to an event that didn't happen ($y_i = 0$). Further observe that both scores decrease—become more negative—as the forecasted probability moves farther away from the outcome, reaching a minimum value when either $p_i = 0$ and $y_i = 1$ or $p_i = 1$ and $y_i = 0$, in which case $\mathcal{S}_B(0, 1) = \mathcal{S}_B(1, 0) = 1$ and $\mathcal{S}_{\log}(0, 1) = \mathcal{S}_{\log}(1, 0) = \log(0) = -\infty$.

Both the Brier and log scores are *proper scoring rules*, meaning that expected accuracy under the true outcome distribution $\mathbf{q}$ is maximized at the forecast $\mathbf{p} = \mathbf{q}$. Thus, a forecaster being evaluated by a proper scoring rule is incentivized to assign forecasts $\mathbf{p}$ that align with his true beliefs about the outcome distribution. See [7] for more details on proper scoring rules.

3.2.1   Caveats of proper scoring measures

Brier and logarithmic scores can be computed from any collection of forecasts $\mathbf{p} = \{p_i\}_{i=1,\ldots,N}$ and corresponding set of outcomes $\mathbf{y} = \{y_i\}_{i=1,\ldots,N}$. But these scores do not, on their own, provide an assessment of forecast accuracy relative to a credible baseline. A naive choice of baseline, for example, would compute the score under the alternative forecast which assigns 0.50 probability to every outcome. We call the corresponding score for these baseline measures the *Naive* score. For example, the Naive Brier score is 0.25 and Naive Logarithmic score is $-\log(2)$ for any collection of binary outcomes.

FiveThirtyEight provides accuracy calculations for past forecasts using Naive Brier scoring as its baseline [6]. FiveThirtyEight's own assessment finds that the 538 election night forecasts, i.e., the final 538 forecast just prior to the announcement of election outcome, substantially outperform this naive 50-50 forecast. We highlight two major flaws of using this as the baseline.

The average voter isn't that naive   The 538 self-assessment compares its forecasts to the performance of a so-called "unskilled forecaster", who assigns 50% to every outcome. The most obvious critique of this approach is that such a naive forecaster should be no match for 538's forecasts, which are built by professionals using sophisticated statistical and computing tools and large amounts of data. If 538 lost to the naive forecaster, it would confirm serious deficiencies in 538's methods, but outperforming the naive forecaster tells nothing about whether 538 is good relative to a credible alternative. Second, a voter with even limited knowledge of U.S. political demographics could accurately predict at least 40 states, possibly even 45 states, with a high degree of confidence. For example, a strategy that predicts each state to be won by the same party as in the election 4 years prior would have also outperformed the unskilled forecast convincingly in terms of Brier score, as shown in Table 3.

11

year	2004	2008	2012	2016	2020
states correct	48	42	49	46	46
Brier score	0.059	0.176	0.039	0.098	0.098

Table 3: Number of correctly predicted states (out of 50 U.S. states plus D.C.) using only the results from 4 years prior.

A person using the above strategy isn't clueless, and therefore isn't "unskilled" by the 538 definition, but they are using a minimal amount of publicly available information in their predictions. Moreover, the forecast relies only on information that is known 4 years before the next election, and it performs almost as well as 538 in terms of raw prediction of state-by-state outcomes.

Scoring rules can't account for dynamic forecasts   The 538 assessment quoted above computes the Brier score based on the final 538 forecast on the night of the election. In the months before an election, however, the 538 forecasts change regularly, sometimes several times a day, in response to new polls or other information. The Brier score based on election night forecasts ignores all of these prior forecasts and considers only the forecast based on the most up-to-date information before the election. Moreover, it isn't clear how to incorporate earlier forecasts into the scoring if one wished to do so.[7] The Brier score on election night forecasts, therefore, isn't a holistic evaluation of 538's forecasts. It also fails to evaluate the forecasts at times that they are most useful: accurate forecasts are more useful to voters, pundits, policymakers, etc. well in advance of the election, when decisions can be made to prepare for or hedge against potential outcomes.

3.2.2   Accuracy of Models and Markets in 2020

Table 3 shows the Brier score for a naive bettor who assigns 100% probability to each state based on the party who won the state four years prior. Table 4 shows the Brier score for 538 and PredictIt based on their respective forecasts on the day before the election. When computed over all forecasts for Senate, House and President, FiveThirtyEight is more accurate than PredictIt, with a Brier score of 0.07 compared to 0.10. However, we note that most of 538's advantage over PI comes from very high and very low probability events, due to the noted longshot biases and structural distortions caused by PI's high fee structure. When we remove outcomes with forecasted probabilities less than 6% and higher than 94%, PI forecasts have a Brier score of 0.16 compared to 538's 0.17.

For the sake of discussion, we could think of refining the naive forecaster from Table 3 by assigning 100% probability for the same party to win as four years ago but only for those states where polling data suggests no major change from the previous cycle. For the remaining "toss up" states, we assign 50% to both parties. For the 2020 cycle, there were between 8 and 12 toss up states, depending on how toss ups are defined. Regardless of choice, the 38-42 non-toss up states would have been predicted perfectly

---

[7]Immediate suggestions that come to mind would be to average the Brier score over the time series of forecasts, but this doesn't account for correlation in the forecast and also the fact that forecasts at times farther in advance of the outcome are likely to be more uncertain, and thus closer to 0.50, than those closer to the event.

Sample	FiveThirtyEight	PredictIt
All	0.07	0.10
$0.06 < p < 0.94$	0.17	0.16

Table 4: Brier scores of 538 and PI forecasts based on forecasts the day before election (November 2, 2020). The second row ($0.06 < p < 0.94$) restricts to forecasts in the range 6%-94% to eliminate possible longshot biases in prediction markets.

and the remaining toss up states contribute 0.25 each to the Brier score, for an overall Brier score in the range 0.04-0.06.

The analysis suggests that a substantial amount of 538's apparent advantage in accuracy may result from PI's structure defects. In this sense, 538's forecasts are more accurate than those of PI, but their superiority seems confined to specific kinds of events for which Markets are already known to suffer. We also see that a much simpler, naive forecasting approach outperforms 538 without the need for a sophisticated model or statistical analysis.

Furthermore, we note that the Brier scores are presented here without any quantification of statistical uncertainty, thus preventing us from properly discerning the extent to which 538's 0.07 Brier score outperforms PI's score of 0.10. We note that such analysis isn't available because of the lack of information about correlation among states.

4   Market-based scoring

In addition to the above mentioned limitations, calibration and accuracy can't be assessed until after the outcomes have been determined. They are, at best, a way to evaluate past forecasts, but they provide no mechanism to assess forecasts in real time. Before an event occurs, how can we assess the forecaster's confidence in their own predictions? What are we to make of forecasts put forth by modelers whose risk of "being wrong" is mitigated by the opportunity to explain poor performance using concepts such as calibration and proper scoring?

In earlier work, Crane [4] argued that one-shot probabilistic claims (such as election forecasts) are meaningless unless they confer risk upon the forecaster. Crane's argument is based on the rationale that hypothetical risk is fundamentally different than real risk. This *Fundamental Principle of Probability* (FPP) can be applied directly to political forecasts, for which betting markets such as PredictIt, IEM, Betfair and others present ample opportunity for forecasters to back up their claims with tangible risk. Active traders in betting markets uphold the FPP every time they trade. Forecasters at 538 and other media outlets, however, do not.

For example, a forecaster who assigns a probability of 85% that Joe Biden will win the 2020 Presidential election should, in principle, be willing to pay any amount up to $0.85 for a contract that pays $1.00 if Biden wins and nothing otherwise. In practice, the forecaster may only be willing to pay up to $0.80 or so, both to account for trading costs and to allow for model error, opportunity cost, etc. The exact value of this upper limit is less important than the fact that the forecaster is willing to incur some risk associated with their beliefs.

The FPP thus provides a straightforward way to compare forecasts by regarding probabilities as prices and computing the profit and loss of each forecast against the prices

13

set by the other. By this principle, prediction markets present worthy competition to model-based forecasts from 538 and others, precisely because the implied market probabilities reflect the decisions of market participants who back up their claims by risking real money.

Our market-based approach is based on the above principle. We follow the earlier analysis of Crane [5], who assessed election forecasts for the 2018 U.S. midterm elections based on their would-be profit and loss under a strategy which invests on election outcomes when market prices are undervalued relative to model output. The findings of that analysis were inconclusive, with 538 outperforming PredictIt in the House of Representatives but underperforming in the Senate. Crane's 2018 analysis was also less comprehensive in that it compared the performance between 538 and PredictIt only at a snapshot in time, rather than throughout the time leading up to the election.

4.1   Description of Market-Based Scoring

The concept underlying *Market-Based Scoring* (MBS) is straightforward: an investor uses the probabilities assigned to each event to make decisions whether to buy or sell contracts based on those events. To formalize, we assume for each event $i = 1, \ldots, N$ there is a probability π_i associated to the event's happening and a market price $0 \le p_i \le 1$ associated to that event's happening (a 'Yes' contract). In many cases, there is also a market price $0 < q_i < 1$ associated to the event's not happening (a 'No' contract). More specifically, a price of p for a Yes contract is an offer to pay \$$p$ in exchange for a contract that will be worth \$1 if the event occurs and \$0 otherwise. Similarly, a price of q for a No contract is an offer to pay \$$q$ in exchange for a contract that will be worth \$1 if the event does not occur and \$0 otherwise. (Note that in general $p + q \ge 1$, so these prices do not correspond directly to probabilities.). For consistency, we frame everything in terms of 'Yes' contracts, so that π_i always refers to the probability that event i occurs. In these terms, a 'No' contract on the event 'Biden wins the general election' is interpreted as a 'Yes' contract on the event 'Biden does not win the general election'.

Given the forecast π and a price p, a strategy $S(\pi, p)$ determines an integer number $\ldots, -2, -1, 0, 1, 2, \ldots$ of shares to buy at that price, with negative values corresponding to a sale of that number of shares. The trader can sell shares that he already owns but cannot sell short, i.e., own a negative number of shares. Therefore, if the trader owns k shares and the strategy calls for selling $m > k$ shares, then the trader will sell all k of his shares. We write $S(\pi, p) = -\infty$ to indicate a strategy that sells all shares at price p for forecast π.

The following are some examples of strategies:

- **Fixed number of shares**: for $k \ge 1$, the strategy

$$S_0(\pi, p) = \begin{cases} k, & \pi > p, \\ -\infty, & \pi < p, \end{cases} \tag{5}$$

  buys exactly k shares if the forecasted probability exceeds the price p and sells all shares if the price exceeds the forecast.

- **Fixed dollar amount**: for $a \ge 0$, the strategy

$$S_{DCA}(\pi, p) = \begin{cases} a/p, & \pi > p, \\ -\infty, & \pi < p, \end{cases} \tag{6}$$

14

buys exactly $a worth of shares if the forecasted probability exceeds the price p and sells all shares if the price exceeds the forecast.

- **Kelly criterion:**[8] writing $b = (1 - p)/p$ to denote the effective odds offered by price p, define
$$f^*(\pi, p) = \frac{\pi b - (1 - \pi)}{b}.$$

Let $B \geq 0$ be the investor's bankroll and let $K \geq 0$ be the number of shares already owned by the portfolio. Then the full Kelly strategy corresponds to

$$S_{KC}(\pi, p) = \begin{cases} \frac{B f^*(\pi, p)}{p} - K, & f(\pi, p) > 0, \\ -\infty, & f(\pi, p) < 0. \end{cases} \tag{7}$$

In words, this strategy buys or sells shares in order to bring the total portfolio investment to $B f^*(\pi, p)$.

Above are just three of many possible strategies. For analysis that accounts for transaction costs and market fees, the strategy should account for such costs. For example, the dollar cost averaging strategy in (6) would purchase a/p shares only if $\pi > p + \epsilon$, where ϵ is chosen to account for transaction costs. We account for such costs in our analysis of 538 vs. PI below.

4.2   Constructing a portfolio for multiple contracts

Given forecasts and prices for events labeled $i = 1, \ldots, N$, we apply a strategy S to each event individually to construct a portfolio $\{K_i\}_{i=1,\ldots,N}$ with a number of Yes contracts owned for each of the events. Table 5 shows an example of two events with the following prices and forecasts and the number of shares purchased by an investor based on the strategies in (5)-(7). Note that the investor buys 0 shares of contract 2 under all strategies because $\pi_i < p_i$.

i	event	π_i	p_i	$S_0(\pi_i, p_i)$	$S_{DCA}(\pi_i, p_i)$	$S_{KC}(\pi_i, p_i)$
1	Biden wins general election	0.90	0.87	10	11	265
2	Republican wins N.C. Senate	0.40	0.48	0	0	0

Table 5: Example of forecast and prices at time 1 for events (1) Biden wins the general election and (2) a Republican wins the North Carolina Senate. For (5), we assume $k = 10$; (6), we assume $a = 10$; and for (7), we assume a bankroll of $1000.

4.3   Adding temporal variation in prices and forecasts

As an event approaches, both forecasters and betting markets adjust in response to new information. To account for this, we allow both prices and forecasts to vary over time, writing $\pi_i(t)$ and $p_i(t)$ to denote the forecast and price at time t that event i occurs. We

---

[8]We note that the Kelly criterion applied in (7) does not account for correlation among different markets. To properly apply the Kelly criterion in this case, such correlation should be accounted for, but our analysis based on 538 probabilities doesn't allow for that because we don't have information about 538's full joint probabilities.

15

assume that forecasts and prices are updated in discrete time units $t = 0, 1, \ldots$, with $t = 0$ the initial time, and we write $K(t) = \{K_i(t)\}_{t \geq 0}$ to be the portfolio allocation at time t, which is constructed based on a strategy as in (5)-(7).

At $t = 0$, we fix $K_i(0) \equiv 0$ for all contracts $i = 1, \ldots, N$. For $t = 1, 2, \ldots$, we choose $K_i(t)$ by either buying or selling shares from the existing portfolio allocation $K_i(t - 1)$ according to the strategy $S(\pi_i(t), p_i(t))$. For example, suppose Table 5 represents $t = 1$, and the following represents $t = 2$:

i	event	π_i	p_i	$S_0(\pi_i, p_i)$	$S_{DCA}(\pi_i, p_i)$	$S_{KC}(\pi_i, p_i)$
1	Biden wins general election	0.91	0.92	$-\infty$	$-\infty$	$-\infty$
2	Republican wins N.C. Senate	0.52	0.48	10	20	88

Table 6: Example of forecast and prices at time 2 for events (1) Biden wins the general election and (2) a Republican wins the North Carolina Senate. For (5), we assume $k = 10$; (6), we assume $a = 10$; and for (7), we assume a bankroll of \$1000.

From Tables 5 and 6, the portfolio allocations among the two contracts and two time periods for the KC strategy are

i	$K_i(1)$	$K_i(2)$
1	265	0
2	0	88

4.4   Scoring by Profit and Loss

To account for changes in portfolio value and bankroll size, due to realized and unrealized profit and loss, we write $V_i(t)$ to denote the value of the i contracts at time t, $T_i(t)$ to denote the investor's total investment in event i up to time t, and $B_i(t)$ to denote the available bankroll (uninvested capital) at time t. Initially, $V_i(0) \equiv B_i(0)$ and $T_i(0) \equiv 0$ for all i, and these amounts are updated with each purchase and sale at subsequent times $t = 1, 2, \ldots$. When the investor purchases k shares at time t for price $p = p_i(t)$, his portfolio allocation, total investment, portfolio value, and bankroll change according to:

$$
\begin{aligned}
K_i(t) &= K_i(t - 1) + k, \\
T_i(t) &= T_i(t - 1) + kp, \\
B_i(t) &= B_i(t - 1) - kp, \\
V_i(t) &= B_i(t) + K_i(t) p_i(t).
\end{aligned}
$$

When the investor sells k shares at time t for price $p = p_i(t)$, the above values become

$$
\begin{aligned}
K_i(t) &= K_i(t - 1) - k, \\
T_i(t) &= T_i(t - 1), \\
B_i(t) &= B_i(t - 1) + kp, \\
V_i(t) &= B_i(t) + K_i(t) p_i(t).
\end{aligned}
$$

We then compute the return on investment (ROI) up to time t as

$$
R_i(t) := \frac{V_i(t) - B_i(0)}{T_i(t)}, \quad t = 1, 2, \ldots. \tag{8}
$$

16

We can define the overall ROI by summing over all contracts. Writing $V_\bullet(t) := \sum_{i=1}^{N} V_i(t)$, $B_\bullet(t) := \sum_{i=1}^{N} B_i(t)$, and $T_\bullet(t) := \sum_{i=1}^{N} T_i(t)$, we have

$$R_\bullet(t) := \frac{V_\bullet(t) - B_\bullet(0)}{T_\bullet(t)}, \quad t = 1, 2, \ldots. \tag{9}$$

4.5   Benefits of Market-Based Scoring

Compared to the statistical measures of calibration and accuracy in Section 3, the proposed market-based scoring method is easily interpretable. Whereas the statistical methods require some technical expertise to understand, and even then their real-world meaning remains unclear, the measure of performance in terms of profit and loss is understandable to experts and non-experts alike. If the model-based investor is profitable, then there is evidence that his forecasts provide a more reliable signal than the markets; otherwise, there is evidence that the markets provide a more reliable signal.

By assessing performance directly in terms of would-be profit and loss, MBS automatically accounts for endogenous forces of market distortion. For example, we saw how the presence of commissions and fees artificially deflated the price for Biden to win CA. Without accounting for the distortion, 538 forecasts appear to outperform PI convincingly on such markets. But when we account for those fees in MBS, the apparent 6% edge diminishes to an edge of 0.46%. This is an important aspect of MBS because, while fees make it harder for a forecaster to outperform the market, the presence of fees are responsible for market inefficiencies which sharp forecasts can take advantage of. And while these inefficiencies are well-known by traders and market researchers, MBS naturally accounts for these issues in a way that more traditional metrics cannot.

4.6   Drawbacks to Market-Based Scoring

Because our analysis is based on a single election cycle, for which there is a great deal of correlation among outcomes, our results can't definitively prove which is superior. We note, however, that this same drawback is present for any scoring method applied to a single election cycle. Moreover, in future cycles, it is likely that Models and Markets will adjust accordingly, to use information differently than in previous cycles. We, therefore, expect the arms race to continue, with both Models and Markets improving with each cycle, for as long as there is sufficient incentive to do so. Nevertheless, we hope that our analysis not only brings clarity to the debate over whether statistical methods or market-based approaches provide the more reliable signal but also provides a framework for evaluating forecasts more generally, for political and other events.

5   Analysis

We apply Market-Based Scoring to evaluate the performance of 538 forecasts against PredictIt markets under two pre-registered strategies: (i) Dollar Cost Averaging, as in (6), and (ii) Kelly criterion, as in (7). The following strategies and subsequent analysis was pre-registered in the first version of this article posted at Researchers.One on October 26, 2020.[9] These strategies were chosen primarily for their simplicity and consistency with general principles of investing. More sophisticated strategies could be analyzed, but at the

---

[9]https://researchers.one/articles/20.10.00004v1

risk of added confusion without offering much additional insight to the general principles at play.

Dollar Cost Averaging (DCA). Dollar Cost Averaging (DCA) is a common approach to passive investing by which an investor takes a fixed amount, say $10, and invests it in the market each day. Due to market fluctuations, the $10 will be worth fewer or more shares as the price goes up and down, and thus on average the investor is buying more shares when the price is low. For example, suppose a three day period, the first day a share costs $1, the second day it costs $0.50 and the third day it costs $0.75. Then on day 1, the investor acquires 10 shares, on day 2 the investor acquires 20 shares, and on the third day the investor owns 30 shares worth $0.75 each for a profit of $2.50 on the $20 investment. In the notation above, DCA corresponds to strategy S_{DCA} in (6).

Kelly Criterion (KC). The Kelly criterion is a protocol for bet sizing in which the investor scales the fraction of his bankroll risked based on his advantage relative to the market. Intuitively, a market price of $0.50 offers a relatively small advantage when the forecast is 0.51 as compared to a forecast of 0.80. Thus, the Kelly investor would risk a larger fraction of his available capital in the latter case than in the former. The Kelly criterion is designed to maximize the growth rate of an investor's capital as follows.

Let $K_N(f)$ denote our wealth after betting a fraction f of our bankroll on each of N bets. For each bet $i = 1, \ldots, N$, let y_i indicate whether the ith outcome resulted in a win ($y_i = 1$) or loss ($y_i = 0$). Total wealth after outcomes $\mathbf{y} = \{y_i\}_{i=1,\ldots,N}$ is given by

$$
\begin{aligned}
K_N(f) &= K_{N-1}(f)(1 + bf)^{y_N}(1 - f)^{1-y_N} \\
&= K_0 \prod_{i=1}^{N}(1 + bf)^{y_i}(1 - f)^{1-y_i} \\
&= K_0(1 + bf)^{\sum_{i=1}^{N} y_i}(1 - f)^{N - \sum_{i=1}^{N} y_i}.
\end{aligned}
$$

Normalizing so that $K_0 \equiv 1$ and defining $S_N = \sum_{i=1}^{N} y_i$ for the number of successful (winning) bets and $F_N = N - S_N$ for the number of failed (lost) bets gives

$$
K_N(f) = (1 + bf)^{S_N}(1 - f)^{F_N}.
$$

We define the growth rate of f by

$$
G_N(f) = \frac{1}{N} \log K_N(f) = \frac{S_N}{N} \log(1 + bf) + \frac{F_N}{N} \log(1 - f),
$$

and we seek to maximize its expectation

$$
\mathbb{G}(f) = \mathbb{E} G_N(f) = p \log(1 + bf) + (1 - p) \log(1 - f).
$$

Taking the derivative with respect to f and setting equal to 0 gives the Kelly criterion

$$
f^* = \frac{bp + p - 1}{b}, \tag{10}
$$

as is used for the strategy S_{KC} in (7).

When applying the Kelly criterion in our analysis, we assume the investor allocates a fixed bankroll of $1000 to each market and buys and sells according to (7) based on the available bankroll at each time t. Though we avoid this difficulty in our present

18

strategy	category	no fees	commission only	commissions and fees
KC	Presidential	+0.004	+0.003	+0.001
KC	Senate	+0.005	-0.000	-0.005
KC	House	+0.022	-0.013	-0.023
KC	Total	+0.002	+0.002	- 0.003
DCA	Presidential	+0.038	+0.010	-0.020
DCA	Senate	+0.012	-0.003	-0.043
DCA	House	+0.120	+0.053	+0.033
DCA	Total	+0.037	+0.010	-0.050

Table 7: Summary of performance based on KC and DCA strategies from the 538 forecasts. The column 'no fees' assumes trading without any of PredictIt's commissions or transaction costs. The column 'commission only' assesses a 10% commission on profitable trades, but no transaction fees. The column 'commission and fees' assesses a 10% commission on profits and a 5% withdrawal fee. These commissions and fees are consistent with PI's current fee structure.

analysis, we acknowledge that this strategy, which assigns a separate bankroll to each contract, does not correspond to the Kelly optimal investment strategy jointly over all contracts simultaneously. The optimal allocation is far more complex in the situation if the investor considers to allocate a single bankroll across all available contracts, as has been discussed elsewhere [5, 15]. Because those calculations cannot be properly applied without full knowledge of the joint probabilities of all outcomes across all contracts, which aren't available, we are unable to test this strategy here.

Our portfolio construction considers all available markets for President, Senate and House of Representatives. The performance of both DCA and KC strategies across all these markets is summarized in Table 7. These results have a number of interesting consequences. First, we see that 538 outperforms the market across the board in the absence of fees and remains barely positive overall after the 10% winning commission is accounted for. But its results turn negative after accounting for the full 5% transaction fee. This observation suggests that the probabilities reported by 538 are more accurate than the probabilities directly implied by PI prices. For example, the $0.94 price for Biden to win California on election morning tells an inaccurate story compared to 538's 99.9% probability of the same outcome. On the other hand, 538's underperformance in the presence of fees suggests that prediction markets may provide a more accurate signal after accounting for known inefficiencies, such as distorted prices in events with very high and very low probability.

So while this observation makes our analysis inconclusive on the question of whether Models or Markets are the more reliable source, it does provide some insight into the situations under which Models beat Markets and Markets beat Models, as well as highlighting the ways in which structural defects of existing markets adversely impact their pricing signal.

On the first point, there exist markets which are known not to be competitive weeks or months before the election. In these cases, the 538 Model gains a theoretical advantage over the Market because the Model assigns a very high probability (> 99%) while the Market often remains at a price of 95 cents or less. In these cases, the Model can gain a near certain return of approximately 5% by purchasing Yes contracts for whichever side

19

is > 99% to win.

The relatively high trading commissions leads to some of the market inefficiencies mentioned above, which in theory could be taken advantage of by the 538 forecasts, but in practice could not be overcome in the presence of transaction costs. In addition to the costs to individual traders, these fees cause market inefficiency for contracts on highly certain outcomes, which allow 538 to inflate its hypothetical profits in the absence of fees, but the advantage disappears when fees are added in. We discussed above the clear price distortion for Biden to win California. This is one of many such offerings, which persist as a result of previously mentioned barriers to efficiency. But even with these inefficiencies, Models can't outperform Markets by enough to overcome the fees.

6   Discussion and Concluding Remarks

The main results of our analysis, summarized in Table 7, show that the 538 forecasts tend to be sharper overall than PredictIt prices as reported, but that 538's forecasts cannot overcome PredictIt's commissions and fees. Though these findings are inconclusive as far as determining which of 538 and PredictIt offers the more reliable signal overall, they are significant in highlighting the relative strengths and weakness of Model and Market-based approaches.

Where does this leave our analysis in terms of our initial questions of whether Markets or Models are more reliable for election forecasting? It seems clear based on this analysis that 538 is better at forecasting highly certain events while PredictIt is better at forecasting uncertain events. Known psychological biases (e.g., longshot biases) as well as market inefficiencies (e.g., asymmetric fees, high commissions, opportunity costs, low maximum exposure) make otherwise lucrative opportunities no longer profitable. Thus, while it is a source of advantage for 538 over the markets, it is explainable by clear design flaws which can hopefully be corrected by better market designs.

6.1   Models do not profit from Markets

Based on the strategies we consider for 538 against PredictIt, the 538 forecasts are modestly better in terms of calibration and Brier score, but are unable to turn a reliable profit. We note that while 538's forecasts are unable to turn a reliable profit, there are a number of professional and semi-professional traders who do consistently make profits in prediction markets. The inability of 538 to profit therefore suggests that their forecasts are failing to account for some critical information that professional traders do account for and which are reflected in market prices to some extent.

One piece of such information that seems to have been priced into the 2020 markets was the likelihood of a systematic pro-Democratic polling error. The anticipation of such a polling error can explain the systematic discrepancy between Models and Markets across all available betting markets for House, Senate and President.

6.2   Need for more transparent reporting of forecasts

Post-election discussion about forecast and prediction market performance is often rife with confusion and biased opinion from proponents of one or the other approach. For example, Nate Silver of FiveThirtyEight and other proponents of Models have acknowledged the polling error in Figure 1 while maintaining that their forecasts were more accurate

than prediction markets. These claims, however, are not based on any well-defined analysis of the relative performance of Models vs. Markets, as we've proposed here, but rather on the existence of specific anomalies, such as the Markets' persistent pricing of Trump victory above \$0.10 more than a month after the election. These arguments cherry pick situations that appear to be skewed in Trump's favor while ignoring that 538 forecasts predicted Biden to win Florida and North Carolina and forecasted the margin in Ohio to be within 1%, when it turned out +8% in Trump's favor. They also ignore that they projected Democrats to win the Senate and to pick up seats in the House. Proponents of Markets argue similarly, emphasizing that the 65% Biden forecast was more consistent with the close election decided by a few key states, rather than the projected landslide victory by 538 and others. Such arguments, though based on empirical evidence, are not supported by a well-defined criteria, as we've proposed here. These post-election debates highlight the need for more transparent reporting and evaluation of political forecasts, as we have attempted here with our pre-registered, Market-Based Scoring analysis.

6.3   Need for symmetric, less exorbitant fee structure

Although our analysis finds that Models do not outperform Markets, it still reveals a number of glaring deficiencies in PredictIt's market design. The asymmetric winner's commission and high transaction costs imposed by PI have visible impacts on market signal and the market's ability to respond to new information efficiently. Even though our analysis finds that PI, on the whole, gives a reliable forecast that outperformed 538 in the 2020 election, the persistence of several markets whose pricing disagrees with common sense, such as Biden's 94% chance to win California or Trump's 14% chance to win the general election as of December 8, hurts the credibility of the overall market.

It is, therefore, our conclusion that both Models and Markets can improve, not only their forecasts but the way they are interpreted and communicated to the general public. Models have a number of positive selling points, but they do not definitively outperform Markets. We recommend more transparent, well-defined metrics for evaluating model performance, along similar lines to the Market-Based Scoring approach proposed above. Research-based markets such as PI and IEM are valuable for gleaning insights about markets and political events, but they lose public acceptance when its prices are badly misaligned with public expectations as a result of drastic inefficiencies. Improvements in market design and operation could help lend credibility to markets and provide a valuable outlet for informing the general public about uncertain political outcomes.

References

[1] K. J. Arrow, R. Forsythe, M. Gorham, R. Hahn, R. Hanson, J. O. Ledyard, S. Levmore, R. Litan, P. Milgrom, F. D. Nelson, G. R. Neumann, M. Ottaviani, T. C. Schelling, R. J. Shiller, V. L. Smith, E. Snowberg, C. R. Sunstein, P. C. Tetlock, P. E. Tetlock, H. R. Varian, J. Wolfers, and E. Zitzewitz. The Promise of Prediction Markets. *Science*, 320(5878):877–878, 2008.

[2] T. Auld and O. B. Linton. The Behaviour of Betting and Currency Markets on the Night of the EU Referendum. *International Journal of Forecasting*, 35(1):371–389, 2019.

RES3ARCHERS.ONE

[3] J. Berg and T. Rietz. Longshots, overconfidence and efficiency on the iowa electronic market. *International Journal of Forecasting*, 2019.

[4] H. Crane. The Fundamental Principle of Probability. *Researchers.One*, (https://www.researchers.one/article/2018-08-16).

[5] H. Crane. Polls, Pundits, or Prediction Markets: An assessment of election forecasting. *Researchers.One*, 2018.

[6] FiveThiryEight.com. How Good Are FiveThirtyEight Forecasts? *https://projects.fivethirtyeight.com/checking-our-work/us-senate-elections/*.

[7] T. Gneiting and A. Raftery. Strictly Proper Scoring Rules, Prediction, and Estimation. *Journal of the American Statistical Association*, 102(477):359–378, 2007.

[8] R. I. McDonald, J. M. Salerno, K. H. Greenaway, and M. L. Slepian. Motivated Secrecy: Politics, Relationships, and Regrets. *Motivation Science*, 2019.

[9] V. Restocchi, F. McGroarty, and E. Gerding. The temporal evolution of mispricing in prediction markets. *Finance Research Letters*, 29:303–307.

[10] D. Rothschild. Forecasting Elections: Comparing Prediction Markets, Polls, and their Biases. *Public Opinion Quarterly*, 73(5):895–916, 2009.

[11] R. Sethi. On Prediction Markets for Climate Change. *https://medium.com/@rajivsethi/on-prediction-markets-for-climate-change-960d430e701e#.o7jlnaphy*, 2009.

[12] R. Sethi. Fee-Structure Distortions in Prediction Markets. http://rajivsethi.blogspot.com/2016/04/fee-structure-distortions-in-prediction.html, 2016.

[13] G. Shafer, V. Vovk, and A. Takemura. Defensive forecasting. In R. Cowell and Z. Ghahramani, editors, *AISTATS 2005*, pages 365–372, 2005.

[14] A. Stershic and K. Gujral. Arbitrage in Political Prediction Markets. *The Journal of Prediction Markets*, 14(1):69–99, 2020.

[15] E. O. Thorp. The Kelly Criterion in Blackjack, Sports Betting, and the Stock Market. *Handbook of Asset and Liability Management*, 1, 2006.

[16] J. Wolfers and E. Zitzewitz. Prediction markets. *Journal of Economic Perspectives*, 18:107–126.

**IN THE UNITED STATES DISTRICT COURT
FOR THE WESTERN DISTRICT OF TEXAS**

KEVIN CLARKE, in his individual capacity, TREVOR BOECKMANN, in his individual capacity, HARRY CRANE, in his individual capacity, CORWIN SMIDT, in his individual capacity, PREDICT IT, INC., a Delaware corporation, and ARISTOTLE INTERNATIONAL, INC., a Delaware corporation,	Case No. 2022-cv-00909
Plaintiffs,	
v.	
COMMODITY FUTURES TRADING COMMISSION,	
Defendant.	

DECLARATION OF CORWIN SMIDT

Pursuant to 28 U.S.C. § 1746, I, Corwin Smidt, do hereby declare:

1.   My name is Corwin Smidt. I am a resident of Michigan, where I am an Associate Professor in the Department of Political Science at Michigan State University. I submit this declaration in support of Plaintiffs' Motion for a Preliminary Injunction.

2.   I have personal knowledge of the facts stated herein.

3.   The PredictIt Market has provided trading data free of charge to the academic community since its inception.

4.   I have used the PredictIt Market and the data it generates in my research on the reliability of public expectations as an indicator of future political outcomes and intended to use PredictIt data again in my future research.

62

5.   I understand that the CFTC has revoked the No-Action Letter under which the PredictIt Market operated and has ordered that the Market close or liquidate all contracts on or before February 15, 2022. These would include certain contracts regarding the outcome of the 2024 presidential elections that I plan to study.

6.   The agency's decision renders trade/pricing data on event contracts that will not close before February 15, 2022 valueless to my research plans. What assists my research is the behavior of market traders trying to accurate predict the outcome of an election or other political event, backed by a small investment that will reduce the risk of personal biases affecting that prediction. I am studying whether the effect of backing a prediction with a small investment affects accuracy and how a liquid market attempting to predict the outcome of an election reacts to certain material events, such as revelations about a candidate or geopolitical developments.

7.   The agency announcement is causing traders now to shift from predicting the correct political outcome to salvaging their investment leading up to February 15, 2022. This understandable market behavior is rendering the PredictIt data useless for my research plans.

8.   Though other political event-contract markets exist or have existed in the past, the PredictIt Market has been a particularly valuable data resource because it offers event contracts further in advance of the events they predict than other markets. This gives researchers, like myself, the opportunity to analyze the public's changing attitudes toward political outcomes based on a variety of factors that unfold well in advance of the event on which the contracts are based.

9.   Additionally, various political-event markets have operated at various points in time and within slightly different parameters, it is difficult to compare data generated between markets with different rules and different cohorts of traders. The distortion in the PredictIt

Market created by the agency's decision will significantly reduce the value of previous research using PredictIt data, as it will be difficult to compare those results to data created by a Market operating under the same rules in future election cycles. The markets varied parameters may produce inconsistent results from one market to the next where as taking data generated by one market under stable parameters over a long period of time would be far more reliable.

        I declare under penalty of perjury that the foregoing is true and correct.

Executed on September 28, 2022   _____

                                          Corwin Smidt