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Comment

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1. Introduction

This is an interesting and informative paper that explores pricing behavior in a new market for macroeconomic derivatives. Asset markets where risk associated with future macroeconomic events can be traded are a recent financial innovation. These markets may allow more efficient sharing of macro risks and increase economic welfare. To assess their potential, it is important to understand how well existing economic derivatives markets function. Analyzing data from one such market where claims on macroeconomic indicators including non-farm payrolls are traded, this paper argues that (1) Expectations derived from market prices are more accurate than survey-based forecasts and less subject to behavioral biases; (2) The market predicts the probability distribution of outcomes remarkably well; (3) Risk aversion plays at most a small role in determining prices in this market.

I begin by discussing potential theoretical foundations for the empirical findings. Then I briefly discuss features of the market mechanism, and finally turn to the role of risk aversion. My comments suggest additional empirical tests that can sharpen our understanding of how markets for economic derivatives function.

2. Theory

Perhaps surprisingly, it is not easy to come up with plausible microfoundations for findings (1) and (2). Why are prices accurate predictors of outcomes? And why are prices more accurate than survey-based forecasts, when in many economic models, prices are functions of the beliefs that forecasts measure? To answer these questions, I begin by exploring the mechanism through which markets may aggregate infor-

mation. A large theoretical literature (e.g., Grossman 1976 or more recently Reny and Perry 2003) argues that markets correctly aggregate heterogeneous information in the presence of common prior beliefs. In practice, however, the common prior assumption appears to be at odds with often-observed disagreement in survey forecasts among professional forecasters, because different individuals with common priors cannot agree to disagree (Aumann 1976). A plausible alternative in this context is to assume that disagreement is due to heterogeneous prior beliefs.

However, with heterogeneous beliefs, as argued for example by Manski (2004), it is not a-priori clear that predictive markets should correctly aggregate information. To see the logic, note that in principle, a wealthy individual with incorrect beliefs may be able to push prices away from fundamental values by the sheer size of her investment. More formally, Wolfers and Zitzewitz (2005) show that with risk-averse investors and a competitive market, the price will equal the wealth-weighted average belief in the population. This result confirms that market prices can depart from true expectations if the distribution of beliefs is correlated with wealth. On the other hand, in this model, accurate market prices obtain if the average belief in the population correctly predicts outcomes. This suggests that the reason why predictive markets function so well is that the average belief of investors is correct.

To test this proposition, one can look for alternative empirical measures of beliefs. A natural candidate, used for example by Mankiw, Reis, and Wolfers (2003), is survey-based forecasts. If one accepts that such surveys are a good measure of beliefs, then the Wolfers-Zitzewitz model predicts that surveys will forecast outcomes at least as well as market prices. However, this prediction contradicts finding (1) of this paper. How can prices be more accurate than surveys, when surveys are a direct measure of investors' beliefs?

To resolve this contradiction, one has to relax one of the assumptions of the previous argument. It must be that either (a) prices are not more accurate than survey-based forecasts; or (b) surveys do not reflect true beliefs; or (c) prices are accurate not because they reflect average beliefs, but for some different reason. Distinguishing between these alternatives would be useful to better understand the workings of predictive markets.

Let us address each possibility in turn. Case (a) suggests that finding (1) in the paper is due to other differences between the survey and market data. Timing is one such difference: while the predictive market

meets on the morning of the data release, the survey is collected up to a week earlier. Given such differences in timing, information that becomes available after the survey is collected may be reflected in the market price. This explanation suggests that surveys are good measures of expectations. From a practical perspective, this would be useful, because survey data is more widely available than data from predictive markets. Using the data of the current paper, this explanation can be tested by comparing the differential accuracy between surveys and forecasts depending on the difference in timing. When this explanation is correct, surveys that take place later should be closer in accuracy to market prices.

Case (b) may hold for example if survey respondents have little to lose from making incorrect predictions, while market participants have money at stake. In this case, earlier work where beliefs are measured using survey based forecasts is potentially misleading. While there is little doubt that predictions do improve when the stakes are higher, the question is quantitative. How much does precision increase when the stakes go up? A preliminary empirical approach to explore this question is to compare the accuracy of predictions across markets with different stakes, as measured perhaps by total investment in short and long positions. In markets with higher total investment, we should find that prices are better predictors of outcomes.

In my view, case (c) is the least likely. If prices do not reflect average beliefs, then we are back to the original puzzle: Why do prices in predictive markets forecast outcomes so accurately?

To summarize, the most plausible theory raises the question of whether finding (1) is caused by the different nature of surveys versus markets or their differential timing, and suggests additional empirical tests to help sort out whether markets are just as accurate as surveys or more accurate because the stakes are small for survey participants.

3. The Pari-Mutuel Mechanism

Understanding the logic of information aggregation in predictive markets is further complicated by the fact that the market mechanism is not competitive. The market is a modified version of the pari-mutuel mechanism often used in horse race betting. Eisenberg and Gale (1959) explore Nash equilibrium in a simple version of the basic pari-mutuel model. They establish existence and uniqueness of equilibrium; how-

ever, the equilibrium they find need not involve prices that correctly predict outcomes. To quote the last sentence in their paper: "In the case of two bettors with equal budgets if the first bettor's subjective probability distribution on two horses is ((1/2),(1/2)) then the equilibrium probabilities will be ((1/2),(1/2)) regardless of the subjective probabilities of the second bettor, as the reader will easily verify." Therefore, in the special case discussed in the quote, the price will be independent of the beliefs of the second bettor. This example suggests that exploring the actual market mechanism in more detail can lead to useful insights about the logic of information aggregation.

4. Risk Aversion

My final topic is the role of risk aversion. Using a simple model with power utility investors, the paper shows that for reasonable coefficients of relative risk aversion the risk premium of holding economic derivatives should be very small. Based on this argument, the authors conclude that risk is unlikely to affect asset prices in predictive markets.

One problem with this logic is that the same calibration argument, if applied to the aggregate stock market, would imply that risk plays at most a minor role in determining expected stock returns, and that the equity risk premium should be very small. As it is well known, this implication of the model is robustly contradicted in the data (e.g., Mehra and Prescott 1985). This equity premium puzzle suggests that the standard power utility model should not be used to assess the effect of risk in influencing asset prices. An alternative approach to gauge the impact of risk on prices is to note that for most investors, investing in predictive markets is likely to be a relatively small risk. There are studies suggesting that decision making in the presence of small risk is well-described by loss-aversion preferences that have a kink at the status quo level of wealth (see for example, Thaler, Tversky, Kahneman, and Schwartz 1997). Calibrating a model with such loss-averse investors would be an empirically more plausible way to assess the role of risk in affecting predictive market prices.

To conclude, this is an interesting paper that documents useful facts about the functioning of economic derivatives' markets. I hope that my discussion helps in suggesting additional empirical tests to sharpen our understanding of the mechanism through which these markets aggregate information.

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