Strategic Trading in Informationally Complex Environments

NICOLAS S. LAMBERT, Graduate School of Business, Stanford University
MICHAEL OSTROVSKY, Graduate School of Business, Stanford University, and Google
MIKHAIL PANOV, Graduate School of Business, Stanford University

We study trading behavior and the properties of prices in informationally complex markets. Our model is based on the single-period version of the linear-normal framework of [Kyle 1985]. We allow for essentially arbitrary correlations among the random variables involved in the model: the true value of the traded asset, the signals of strategic traders, the signals of competitive market makers, and the demand coming from liquidity traders. We first show that there always exists a unique linear equilibrium, characterize it analytically, and illustrate its properties in a series of examples. We then use this equilibrium characterization to study the informational efficiency of prices as the number of strategic traders becomes large. If the demand from liquidity traders is uncorrelated with the true value of the asset or is positively correlated with it (conditional on other signals), then prices in large markets aggregate all available information. If, however, the demand from liquidity traders is negatively correlated with the true value of the asset, then prices in large markets aggregate all available information *except* that contained in liquidity demand.

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Extended Abstract

Whether and how dispersed information enters into market prices is one of the central questions of information economics. A key obstacle to full information revelation and aggregation in markets is the strategic behavior of informed traders. A trader who has private information about the value of an asset has an incentive to trade in the direction of that information. However, the more he trades, the more he reveals his information, and the more he moves the prices closer to the true value of an asset. Thus, to maximize his profits, an informed trader may stop short of fully revealing his information, and thus the informational efficiency of market prices may fail.

Thus, an important and natural question is when we should expect market prices to in fact reflect all information available to market participants. One intuition proposed in the literature is that we should expect such outcomes when the number of informed traders is large, and each one of them is informationally small. In that case, each of the informed traders has limited impact on market prices, but their aggregate behavior does in fact reflect the aggregate information available in the market. As a result, market prices are close to those that would prevail if all private information were publicly available, and all trades happened at those prices.

Non-strategic explorations of this intuition go back to [Hayek 1945], [Grossman 1976], and [Radner 1979]. Subsequently, a line of research has considered strategic foundations for this intuition, studying strategic behavior of informed agents in finite markets, and then considering the properties of prices as the number of these agents becomes large. This stream of work, however, imposes very strict assumptions on how

This work is supported by the National Science Foundation, under grant No. CCF-1101209. Authors' address: Stanford Graduate School of Business, 655 Knight Way, Stanford, CA 94305; emails: {nlambert,ostrovsky,mpanov}@stanford.edu.

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information is distributed among the agents, typically assuming that the signals of informed agents are symmetrically distributed, or satisfy other related restrictions so that in equilibrium, the strategies of all informed traders are identical. In practice, however, the distribution of information in the economy can be much more complex. Some agents may be strictly more informed than others. Groups of agents may have access to different sources of information, so that the correlations of signals within a group are very different from correlations across groups. Some agents may be informed about the fundamental value of the security, while others may possess some "technical" information about the market or other traders. And of course all such possibilities may be present in a market at the same time.

Our paper makes two main contributions. First, we present an analytically tractable framework that makes it possible to study trading in such informationally complex environments. Our model is based on the single-period version of the model of [Kyle 1985]. As in that paper, an important assumption that makes our model analytically tractable is the assumption of joint normality of random variables involved in the setting: the true value of the traded asset, the signals of strategic traders, the signals of competitive market makers, and the demand coming from liquidity traders. Beyond that assumption, however, we impose essentially no restrictions on the joint distribution of these variables, making it possible to model informationally rich situations such as those described above. In this framework, we show that there always exists a unique linear equilibrium, which can be computed analytically.

Second, we explore the informational properties of prices as the number of informed agents becomes large. We assume that there are several types of agents, with each agent of a given type receiving the same information, and fix the matrix of correlations of signals across the types. We then allow the numbers of agents of every type to grow. We find that the informational properties of prices in these large markets depend on the informativeness of the demand from liquidity traders. If the demand from liquidity traders is uncorrelated with the true value of the asset or is positively correlated with it (conditional on other signals), then prices in large markets aggregate all available information. If, however, the demand from liquidity traders is negatively correlated with the true value of the asset, then prices in large markets aggregate all available information *except* that contained in liquidity demand.

We also illustrate our model with several applications. One example shows that under fairly simple (but, crucially, asymmetric) information structures, an informed trader may choose to trade "against" his information, i.e., sell the asset when his signal implies that the expected value of the asset is positive, and vice versa. Two examples explore the profitability of "technical" trading, and show that a trader may be able to make substantial positive expected profit even if he has no information about the value of the asset, provided there is at least one other ("fundamental") trader who does, and provided that the technical trader has information about the demand from liquidity traders or about the mistakes of the fundamental trader. Finally, our last set of examples shows how equilibrium trading and outcomes depend on the amount of private information available to the market maker (beyond the aggregate market demand).

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