Information Aggregation with Endogenous Ordering*

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Abstract

Investment decisions are often based on private information and on observing other investors' choices. If choices are made sequentially and timing is determined endogenously, choice ordering may reveal others' information quality. In our experiment with endogenous timing, subjects receive either strong or weak signals. Due to waiting costs, subjects with strong (weak) signals have an incentive to invest immediately (wait). As expected, investment success is significantly higher than in a similar framework with random ordering. However, participants' impatience prevents information aggregation relatively often. Based on the sophistication of subjects' timing decisions, three types are identified. The classification helps to explain prediction precision both analytically and in a computer simulation.

JEL: D8, C92, D4

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Extended Abstract

Decision making in a competitive environment consists of at least two components: the timing when to make the (irreversible) decision and the decision itself. Waiting longer is usually costly because the risk of making an early decision has to be compensated. But the benefit might offset this cost if others' decisions are publicly observable and are based on common knowledge about the underlying information structure. Then, waiting can reduce the risk of making the (ex post) wrong decision. This may also lead to rationally ignoring one's own private information and to following others' observable decisions, i.e., rational herd behavior or information cascades.[1]

There are many situations in which this dilemma arises. For example, consider negotiations between different banks and a potential borrower. If one of the banks that usually has good private information because of thorough research, is willing to lend money at specific conditions, other banks will follow but at somewhat inferior conditions. The same pattern can be found in the underwriting of insurance claims by reinsurance companies.[2] In financial markets, the price reaction to new public or private information depends partly on the timing and the used updating procedure(s).[3]

Given the above examples, it is reasonable to assume heterogeneity in agents' information precision either because of heterogeneous access to information or because of information acquisition skills. Then, endogenous timing is crucial as

[1]The information cascade literature *without* waiting costs is based on Banerjee (1992), Welch (1992), and Bikhchandani, Hirshleifer and Welch (1992) [BHW]. Anderson and Holt (1997) tested the BHW model in a first experiment.

[2]See also Grenadier (1999) for more references and a model of information revelation through option exercise.

[3]See also the example provided by Gul and Lundholm (1995, p. 1043): "A firm may wait to observe another firm's success with a new product before deciding how vigorously to enter the market, but the delay will cost the firm some market share if it subsequently chooses to enter. The simple discounting of future payoffs creates a delay cost."

it allows agents to act on differences in information precision. We introduce endogenous ordering with waiting costs in the experimental setting of Nöth and Weber (2003) with two states and private information with two signal strengths. Six participants have to make an irreversible investment decision. They have to choose between two projects A and B which pay v^+ if a project is successful and v^- with $v^+ > v^-$ otherwise. If project A is successful, project B fails and vice versa. The success of both projects is ex ante equally likely. Private information in favor of either project can be strong or weak with an accuracy of $4/5$ or $3/5$, respectively. The distribution of private information with respect to signal content and signal strength is common knowledge. Each agent has to pay (constant) waiting costs for every second without making a decision. As a consequence, subjects have to balance greed and fear. Acting early because of greed or overconfidence avoids paying waiting costs, but the investment decision then relies mostly on private information. Waiting and thus observing others' predictions may result in paying higher waiting costs than necessary.

Information cascades can arise in the experiment because agents can only decide between the two possible states and cascades are individually desirable as long as they increase agents' payoffs, i.e., avoiding ex post wrong decisions by observing others' decisions. As in Gul and Lundholm (1995) a higher signal precision implies an earlier decision due to waiting costs. Thus, other agents are able to infer not only the private information but also, at least to some extent, the quality of the signal.

In our experimental setting, we develop a Bayesian benchmark for both components of the *timing trade-off*: the *timing decision* with respect to the maximum waiting time (and hence investment position) as well as the *updating decision* using private and public information. The timing decision involves foresight in the form of an anticipatory updating decision, i.e., whether a decision can be based on more public information later or not, see also Ivanov, Levin and Peck (2009).

We show theoretically that agents with a strong signal have an incentive to invest

immediately while agents with a weak signal have an incentive to wait. This relative structure holds even in the absence of waiting cost while the immediacy results from introducing positive but small waiting costs. By this endogenous ordering effect, predictions based on strong information are rationally observed at the beginning, i.e., the first prediction is almost fully revealing and information cascades will be the rule rather than the exception. Deviations from this timing structure are termed *timing errors*. As a corollary, agents who time their decisions optimally also predict the ex post correct state more frequently.

Based on data from a laboratory experiment with 108 subjects in 18 sessions (7,254 observations), we find pronounced support for the ordering effect; but timing errors impair rational information aggregation since about 30 percent of all investment decisions at the first position are based on weak signals. Complete cascades account for about 45 percent of all observed histories. However, subjects commit timing errors *and* updating errors. Individual welfare is improved with respect to stand-alone decisions and comparable exogenous ordering settings but falls short of the optimal choice level. Three types of deciders are identified based on their (in)ability to time their decisions according to the Bayesian benchmark. These three types explain the observed prediction precision and a simulation combining the type classification with heuristic decision rules supports this finding. Thus, timing decisions can serve as an estimator of prediction precision and with endogenous ordering, information aggregation is truncated even further than with exogenous ordering.

References

Anderson, Lisa R. and Charles A. Holt, "Information Cascades in the Laboratory," *American Economic Review*, 1997, *87* (5), 847–862.

Banerjee, Abhijit V., "A Simple Model of Herd Behavior," *Quarterly Journal of Economics*, 1992, *107* (3), 797–817.

Bikhchandani, Sushil, David Hirshleifer, and Ivo Welch, "A Theory of Fads, Fashion, Custom, and Cultural Change as Informational Cascades," *Journal of Political Economy*, 1992, *100* (5), 992–1026.

Grenadier, Steven R., "Information Revelation Through Options Exercise," *Review of Financial Studies*, 1999, *12* (1), 95–129.

Gul, Faruk and Russell Lundholm, "Endogenous Timing and the Clustering of Agents' Decisions," *Journal of Political Economy*, 1995, *103* (5), 1039–1066.

Ivanov, Asen, Dan Levin, and James Peck, "Hindsight, Foresight, and Insight: An Experimental Study of a Small-Market Investment Game with Common and Private Values," *American Economic Review*, 2009, *99* (4), 1484–1507.

Nöth, Markus and Martin Weber, "Information Aggregation with Random Ordering: Cascades and Overconfidence," *Economic Journal*, 2003, *113*, 166–189.

Welch, Ivo, "Sequential Sales, Learning, and Cascades," *Journal of Finance*, 1992, *47* (2), 695–732.