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Inertia in social learning from a summary statistic

Nathan Larson

Department of Economics, American University, 4400 Massachusetts Avenue NW, Washington, DC 20016-8029, United States

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Abstract

We model normal-quadratic social learning with agents who observe a summary statistic over past actions, rather than complete action histories. Because an agent with a summary statistic cannot correct for the fact that earlier actions influenced later ones, even a small presence of old actions in the statistic can introduce very persistent errors. Depending on how fast these old actions fade from view, social learning can either be as fast as if agents' private information were pooled (rate n) or it can slow to a crawl (rate $\ln n$). Consistent with Vives (1993), the fastest possible rate of learning falls to rate $n^{(1/3)}$ if actions are also observed with noise, but may be much slower. Increasing the sample size of the summary statistic does not lead to faster asymptotic learning and may reduce short run welfare.

JEL classification: D80; D83

Keywords: Social learning; Asymptotics; Slow learning; Echo chamber

1. Introduction

We introduce a model of social learning in which people learn from statistics over other people's past actions. In the baseline model, this statistic is an average over a large pool of past actions; one could think of it as some kind of macroeconomic indicator. In a variation, the statistic is an average over a small, idiosyncratic sample of actions; one could think of this as word of mouth learning. The key feature in both cases is that the signal *summarizes* history: context about

E-mail address: nlarson@american.edu.

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the sequence of individual past actions is lost. This lack of context is costly because it prevents people from unraveling interdependencies among past actions generated by social learning in the past. Our main aims in the paper are to show that this typically gives excess influence to older information, and to study how this excess influence affects the speed of learning.[1]

The baseline model PA (for population average) builds on Vives (1993). A new cohort of agents arrives at each stage $(1, 2, \dots, n, \dots$ and so on) and must choose an action once and for all in order to minimize a quadratic loss function. The common optimal action θ is unknown, but each agent receives a private signal, normally distributed around θ, and an observational signal based on prior agents' behavior. After acting the agent passes into an observation pool: this is a collection of agents whose actions remain visible or on display, in a sense that we clarify momentarily. Agents who are already in the pool exit from it at some rate; this is a shorthand way to say that their actions no longer contribute to observations by future agents. The observational signal that an agent sees before deciding is the *mean* action in this pool. The only difference in the sample average (SA) variation of the model is that each agent sees the mean of a random sample of actions drawn from the observation pool, rather than the average over the whole pool.

For the baseline model, the observation pool can be interpreted as the set of past actors who contribute to some aggregate measurement. To illustrate, imagine that new cohorts of youths arrive periodically and make decisions about how much education to acquire. Each of them can see a statistic on the average educational attainment of adults in the labor force. In this case, the observation pool – the labor force – reflects the past education choices of people who are still working. Because older people are more likely to have left the labor force, the observational signal is (to a first approximation) a recency-weighted average of past choices.[2] As a second example, suppose that most people begin to save seriously for retirement around age forty, make once-and-for-all decisions about a savings rate, and agree that aiming for a 70% ratio of retirement income to current income is desirable.[3] The savings rate needed to hit this goal is uncertain, but people can see a government statistic on the average savings rate among 40–50 year olds. In this case, the observation pool consists largely of decisions that are one to ten years old, but there may be some older decisions as well. To illustrate a case where the "statistic" is less literal, consider a small farmer in a developing country whose village has adopted a new crop. In deciding how heavily to irrigate his field he may look at the level of the local reservoir to get an indication of the average water use by farmers who planted earlier than him. The observation pool model is well suited to other situations where people see a blend of recent and older actions; by varying the rate at which old actions exit out of the pool, one can give the decisionmaker an average of all past actions, or only the most recent ones, or a recency-weighted blend.

The sample average model describes settings where no comprehensive public statistic is available, and people collect a few examples to guide their decisions. For example, a new employee organizing her retirement plan may ask a few of her co-workers about the stock-bond allocations they chose, or a sprinter interested in optimizing his diet may browse a few web sites to

[1] Herding on a sub-optimal action is not a possibility in our model; the continuous action space ensures that learning always continues and beliefs eventually converge to the truth. However there are natural comparisons between the mechanisms that cause *slow* learning in our model and the factors that stop learning in herding models – we touch on these later in this section.

[2] Of course, other factors besides age can affect the set of predecessors that is available to observe. Selection of the observational signal along non-age dimensions creates additional interesting issues for social learning, but we will not tackle those issues here.

[3] Of course, the savings rate is not really a once-and-for-all decision, but there is considerable evidence (e.g. Duflo and Saez, 2003) that people do not revise their retirement plans very often.