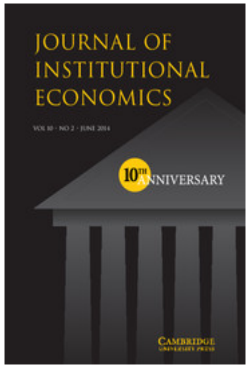

Reply to “Modeling the evolution of preferences: an answer to Schubert and Cordes”

CHRISTIAN SCHUBERT, CHRISTIAN CORDES and PETER J. RICHERSON

Journal of Institutional Economics / Volume 10 / Issue 02 / June 2014, pp 349 - 351
DOI: 10.1017/S1744137414000010, Published online: 24 January 2014

Journal of Institutional Economics (2014), 10: 2, 349–351
© *Millennium Economics Ltd 2014* doi:10.1017/S1744137414000010
First published online 24 January 2014

Reply to "Modeling the evolution of preferences: an answer to Schubert and Cordes"

CHRISTIAN SCHUBERT*
Brandenburg University of Technology, Cottbus, Germany

CHRISTIAN CORDES**
University of Bremen, Bremen, Germany

PETER J. RICHERSON***
University of California at Davis, Davis, USA

In their comment "Modeling the evolution of preferences: an answer to Schubert and Cordes" (2013, this journal), Kapeller and Steinerberger claim to have identified some flaws in the formal argument developed in our paper "Role models that make you unhappy: light paternalism, social learning, and welfare" (2013, this journal). Specifically, they maintain that there is no runaway dynamic in consumption and preference values and that our model therefore always leads to a stable society. In their proof, Kapeller and Steinerberger show that their system is bounded by the highest and lowest preference and consumption levels in the population and can never escape them. Their argument does, however, not apply to the system of coupled dynamic equations we employed to model runaway consumption.

There are no upper limits to the preference values and consumption levels, i.e., the p and x values respectively, of individuals in a population like the one we model. We modeled the consumption and preference traits as quantitative characters (measurable by real numbers). The population of individuals in such a model has a variance for each of these characters, G_x and $G_{p.}$ We assume that these variances are fixed and evolve to an equilibrium value independently of the changes in the means of x and p during the runaway process. This assumption is justified because the equilibrium variance for a quantitative character does not depend upon mean values of the characters, at least not in the basic models drawn from population genetics. Each generation new random transmission errors add variation to the population and the equilibrium variance is determined by the

*Email: c.schubert@tu-cottbus.de
**Email: c.cordes@uni-bremen.de
***Email: pjricherson@ucdavis.edu

rate of random errors independently of changes in the mean value of x and p. A blending effect and selective processes (biased transmission in our model) reduce variation. As x and p evolve, new random variation extends the tail of the distribution of the characters. For a detailed discussion see, for example, Boyd and Richerson (1985, pp. 70–76).

The "bare bones" of our argument look like this: initially, agents' preference levels exceed their consumption levels ($p > x$; "people want to consume more"). Then, according to equation (1) in our article, the consumption levels of all members of the population increase. Due to our assumption that agents with a higher level of consumption, x, are also endowed with higher p values ("rich people have even more accentuated preferences"), all the p values entering equation (2) in the next time period are higher than before. For an individual's updated p value is a weighted average of all p values in the population, also the p value of the agent with the hitherto highest p value grows. As long as trait variances remain stable, there is no upper boundary represented by this individual that limits the dynamic. Of course, consumption cannot grow to infinity so in the eventually the runaway process will be brought to a halt, but the runaway process is certainly not limited to the bounds of variation present in the starting population.

For this dynamic to happen, the assumption of a correlation between x and p values within individuals is indispensable: in our model, a covariance term captures the fact that people with high consumption levels exhibit even higher preferences levels as to what they think is an appropriate level of consumption. As in models of sexual selection, on which we draw, this covariance, B_{xp}, describes the relationship between two genetic traits. In all cases, the covariance is crucial in order to have a runaway dynamic.

Kapeller and Steinerberger's proof does not contain this critical covariance between x and p! They analyze equations (1) and (2) in isolation without regarding the coupled interactions between these recursions. Their proof does not, therefore, get to the core of our model's dynamical structure and thus cannot model the runaway dynamic. This dynamic does not take place during merely one iteration step of the difference equation system. Rather, it results from iterating a system of coupled equations. The essential "covariance argument" is introduced in our text (page 144), included in later equations (starting with equations (5) and (6)), and inevitable in order to have a system with a runaway dynamic. We agree that, given a model without variance and covariance terms Kapeller and Steinerberger's proof is true (which is easy to see, since their proof is simple and clear). As Einstein is supposed to have said, models should be as simple as possible but no simpler. Kapeller and Steinerberger's model is too simple.

Concerning the Taylor series approximation issue brought up by Kapeller and Steinerberger in their comment, we do not see how Kapeller and Steinerberger arrive at the first equation in their section 1.2. It is not equivalent to our equation (3) to which we apply the Taylor series approximation. Furthermore, obviously, the Δx in Kapeller and Steinerberger's expression does not capture the development of $\bar{x}$, as claimed in their preceding sentence and done in our equation (3).

The same Taylor series approximation is used by Richard McElreath and Robert Boyd in their book "Mathematical Models of Social Evolution" (2007, p. 305ff). Their model is based on earlier versions by Kirkpatrick and Lande who also apply such an approximation. The standard justifications for dropping the higher order terms in the Taylor series in evolutionary dynamics are that evolutionary forces are often weak, making the higher order terms insignificant, and even in cases where forces are strong, dropping these terms still usually yields the right intuitions about the behavior of the system. Many models of sexual selection used in population biology, starting with Fisher (1930), Lande (1981), and Kirkpatrick (1982) are very similar to ours. More recent contributions applying a similar approach to ours and potentially exhibiting a runaway process include Iwasa *et al.* (1991), Boyd and Richerson (1985, pp. 259–266), and McElreath and Boyd (2007, ch. 8.2). In these publications, interested readers can find lengthy discussions of the points we have made.

We leave it to the readers of this journal to judge how compelling the "logical" argument is developed in Kapeller and Steinerberger's section three.

We do not comment on Kapeller and Steinerberger's segregation model. If they have an interesting point here, they should dedicate a self-contained paper to it. Given our arguments above, their model is, however, very different form the one devised in our article.

References

Boyd, R. and P. J. Richerson (1985), *Culture and the Evolutionary Process*, Chicago: University of Chicago Press.

Fisher, R. A. (1930), *The Genetical Theory of Natural Selection*, Oxford: Clarendon Press.

Iwasa, Y., A. Pomiankowski, and S. Nee (1991), 'The Evolution of Costly Mate Preferences II. The "Handicap" Principle', *Evolution*, **45**: 1431–1442.

Kapeller, J. and S. Steinerberger (2013), 'Modeling the Evolution of Preferences: An Answer to Schubert and Cordes', *Journal of Institutional Economics*, forthcoming.

Kirkpatrick, M. (1982), 'Sexual Selection and the Evolution of Female Choice', *Evolution*, **36**: 1–12.

Lande, R. (1981), 'Models of Speciation by Sexual Selection on Polygenic Traits', *Proceedings of the National Academy of Science (USA)*, **78**: 3721–3725.

McElreath, R. and R. Boyd (2007), *Modeling the Evolution of Social Behavior: A Guide for the Perplexed*, Chicago: University of Chicago Press.

Schubert, C. and C. Cordes (2013), 'Role Models that Make You Unhappy: Light Paternalism, Social Learning, and Welfare', *Journal of Institutional Economics*, **9**: 131–159.