Report on "Evolutionary model of the bank size distribution'

The author derives the distribution of banks size from a dynamical model similar to those used in biology to describe competition between species. In the model banks issue loans and interact through restructuring processes, interbank money exchange due to economic activities and competition for depositors. The growth dynamics of banks can be described in terms of a set of coupled stochastic equations that the author solves using approximation techniques.

I think the topic addressed in this paper is interesting and the idea of idea of deriving the distribution of banks size from an evolutionary model is sound.

I must confess that I could not completely follow the derivation of the results, and I think it would be useful to provide more intuition and justifications for the assumptions made and the approximation schemes used in the paper.

I detail in the following some specific points I would like the author to comment on.

1. I think the paper may be better placed in the literature. I am not an expert on the subject, but there is for instance a substantial literature concerning the distribution of firms size that seems to be relevant for the current paper. It may be useful to discuss some of this work more in detail and to explain how the dynamics of the banking system differs from that of other firms. In fact, the equations derived in the paper seem to be quite general and may probably be used to describe systems other than the banking one (of course with a different interpretation of the various terms).

   Some useful references may be the following:

   Bouchaud, J., and M. Mezard (2000), " Wealth Condensation in a Simple Model of Economy", Physica A, 282, 536-545.

Gabaix, X. (2008), "Power Laws in Economics and Finance". Annual Review of Economics, 1, 255-293.

Malevergne Y., A. Saichev and D. Sornette, (2013) "Zipfs law and maximum sus- tainable growth", J. Econ. Dyn. and Control 37, 1195-1212.

2. Most of the analysis is based on the separation of typical time-scales for the different processes discussed on page 5. I think these assumptions should be justified. For instance, why are restructuring processes occurring at the same time-scale as banks competition for banks deposits? Why are these processes occurring on a faster time-scale than money creation?

3. Is equation 20 missing a normalization?

$$\xi = -\sum_{i=1}^{n} f_i s_i \rightarrow \xi = -\frac{\sum_{i=1}^{n} f_i s_i}{\sum_{i=1}^{n} s_i} \tag{1}$$

4. I am missing something important about Equation 25 and its solution. Equation 25 seems to be a system of coupled equations because $\rho(t)$ depends on $\langle f \rangle = \sum_i f_i s_i / \sum_i s_i$. The approximation that ρ can be treated as white noise effectively gets rid of any coupling between different banks. Do I understand it correctly? Actually it seems to me that the quantities δf_i are not independent: if someone has a higher than average fitness, someone else must have a lower than average fitness. Can the author please clarify the nature of the approximation, the range of its validity and explain to what extent interactions between banks are accounted for in the solution of equation 25?

5. Is there an interpretation of the parameter M defined in section 2?

6. What is the reason for assuming $s_i < 1$ for all i?

7. From the description gave in section 2 the number of banks $n(t)$ seems to be a variable of the model, and in fact equation 8 contains a term that accounts for restructuring processes. What is the equation describing the dynamics of $n(t)$?

8. From what I understand the following conditions hold: $\sum_i \beta_i(t) s_i(t) = 0$, $\sum_i \eta(t) s_i(t) = 0$, $\sum_i y_i(t) s_i(t) = 0$. This should be clearly spelled out in section 2.

9. Equation A3 seems to assume $\sum_i s_i = 1$ (as also equation 19, see point 3 above), but the variables s_i defined in section 2 do not necessarily sum to 1.

10. the last reference (Richmond and Solomon 2000) should be updated.