Report for *Prudential Regulation in an Artificial Banking System*

The above mentioned paper develops a small scale Agent-Based model of the macroeconomy in order to discuss regulation of the banking sector. The model features, firms, banks, private households, and a central bank (setting the regulatory framework). Firms produce consumption goods that are consumed by private households. Banks can provide consumption loans to private households and investment loans to firms. The authors argue that banks are important for growth by supplying credit to productive firms. In the model, stricter capital requirements hamper economic growth by reducing the credit supply of banks. Banks are found to be more important in downturns in order to provide liquidity. Yet, in numerical explorations counter-cyclical capital buffers are not found to be useful. Finally, the authors argue that not bailing-in low performing banks is useful in order to not end up with *Zombie-banks*.

In my opinion, the paper addresses a highly relevant and topical issue using a sophisticated model. Yet, I am not entirely convinced by the (far-reaching) policy conclusions derived in the paper.

First, I think some modeling assumptions have to be better explained. The following questions emerged while reading the paper:

1. Why does (productive) capital K not matter for the equity ratio in eq. 5?
2. What are the initial conditions when simulating following the protocol as laid out on p. 11. E.g. what is X_0^e in eq. 9?
3. Before eq. 10 it is said that demand is equally distributed among all firms. Why do you introduce heterogeneous firms in the first place?
4. What is the rationale for eq. 12 and 13? Please provide a thorough discussion. They are hard to grasp.
5. It could be helpful to point out that the deposit interest rate (eq. 14) decreases with excess demand for credits.

6. What is S_t^e in eq. 16? In general, a table featuring all parameters and (!) variables with their mathematical symbols could be helpful to guide the reader.

7. The discussion of eq. 17 features the parameter N which is not included in the respective equation. What is B? Does M in this equation represent maturity?

8. In the end of section 2.7 it is said that consumers sell *land*. What is *land* and how is it modeled exactly. There is no other reference up to that point in the paper.

9. Eq. 24 seems inconsistent with equation 19ff. Equation 25 seems inconsistent with eq. 16 ff. Please explain.

10. The modeling of the financial market trading (section 2.10) is highly unusual and hard to grasp. Maybe, the authors want to incorporate a simple and well-used model such as e.g. Westerhoff (2008).

11. The combination of eq. 33 and 34 seems flawed. Is P_t recursively defined by itself?

Regarding the analysis presented in section 3 the following questions emerge:

1. I think the analysis provided in section 3.1 which completely shuts down the banks is not very insightful. As stated on p. 31f. the presence of a capital depreciation rate implies that without banks firms will run out of productive capital and thus are *doomed to fail* without a supply of credit as provided by the banks. Please discuss this more thoroughly.

2. The aggregate growth seems to be superimposed on the model by assuming exogenous growth of consumption and exports (driving the demand for goods). Please discuss.

3. I am not entirely convinced that the capital share (as depicted in fig. 7) will ever increase in time. I think this results from the increasing returns (see fig. 8). I have the feeling that the rate of rate of return should converge to the capital productivity $\Phi = 0.1$ (cf. table 3) in the long run implying a long-run stationary functional distribution.

4. It seems that (at least in the baseline scenario) a defaulting bank is replaced by some exogenous institution that can always and perfectly meet the demand for credit. I think this is a strong assumption in particular regarding the analysis which concerns *Zombie-banks*. The assumption presented in section 3.4 seems more reasonable. I think a more thorough discussion of this issue is necessary.

5. I find the point raised in section 3.2 interesting. Is there a trade-off between the default of firms as compared to banks?

6. In the discussion of the inflection point p. 33 and fig. 9ff. the authors infer a non-linear behavior out of three observations (low, middle and high) only. This is not very convincing.

In general, I would be interested in the role of debt for consumers. In the paper, there are two forms of loans: productive loans to firms and consumer loans. The literature discussing the recent financial crisis has emphasized the role of private debt (cf. e.g. Mian and Sufi (2010)). I have the impression that the positive role of banks emphasized in the paper comes from the fact that they provide loans to the productive sector. On the other hand, excessive leverage of private households is identified as a main driver in the literature that tries to explain the financial crisis. Can private households turn bankrupt in the model at hand?! I do not find a reference to this in the protocol on p. 11.

Minor remarks

1. P.4 *to benefit* rather than to *befit*.
2. In eq. 8 I would use the greek alpha rather the proportionality operator ($\propto$).
3. The figures often credit *Authors* as the source. I think this is not necessary. The data source for the empirical values in table 1 yet should be provided.
4. The numbering of the section does not make sense. In particular section 3 features section 4.1 etc. I would also highly recommend to check the cross-references within the paper.
5. Table 2 only features simulation results. It would be useful to also have real data values as a comparison.

References

Mian, A. and A. Sufi (2010). Household Leverage and the Recession of 2007-09. *IMF Economic Review 58*(1), 74–117.

Westerhoff, F. H. (2008). The Use of Agent-Based Financial Market Models to Test the Effectiveness of Regulatory Policies. *Journal of Economics and Statistics (Jahrbuecher fuer Nationaloekonomie und Statistik) 228*(2+3), 195–227.