Referee Report on "Debt, deleveraging, and business cycles. An agent-based perspectives" (MS566)

This is an interesting paper in which the authors apply the agent-based methodology to explore significant macroeconomic properties, and particularly the role of debt and deleveraging in affecting business cycles. The paper presents a rich modelling setup and model dynamics are studied by means of computational experiments. In our opinion, the paper could be published in the Journal but the authors should first consider a series of revisions to the current version.

Major revisions

The authors maintain that the assumptions made in the model derive from the management studies, behavioural and experimental economics, psychological literature on decision making. We agree with the authors that this is the right way to empirically assess the relevance of agents' behavioural rules and of interaction mechanisms. At the same time, we noted that in some cases the authors followed this principle while there are rules or mechanisms for which no references are provided: for example, about the investment goods sector, the labour market, the banking sector, etc. In some cases there is a reference to the "standard managerial methods": we think that the authors should provide some references for readers not so accustomed with this literature. However, we think that authors assumed reasonable rules of behaviour, even when an appropriate reference is not provided. The suggestion is to always provide some empirical or experimental supports, if possible.

It is not so clear to this referee the working of the labour market. There are many statements related to workers, wages, the demand for labour, and so on, but the paper lacks a clear explanation of how the labour market works. In my view a better description is needed to understand the interplay between labour market dynamics and the business cycle.

In the subsection 7.1 (at the end of page 22), it is explained that unemployment remains high while production declines (after the peak). This 'labour hoarding' result seems to be reasonable in the scenario the authors proposed, and it seems to be the consequence of some 'rigidity' in the labour market. At the same time, it is not completely clear the way in which it happens in the model. Moreover, what about labour supply? While there is an explanation for firms' labour demand, we did not find an accurate description of labour supply. The interaction between demand and supply in the labour market has relevant implications for employment and wage dynamics. So, the authors should make clear this point.

The simulation of the model is performed for 20 (computational) years: given the assumption of a fixed number of households it seems that labour supply is constant over the two simulated decades. This is an assumption that should be motivated. The same observation holds for the constant number of firms and banks. Moreover, the choice made by authors does not seem in line with the statement that "one mail goal of EURACE ... as the number of involved agents goes up" (Section 1, page 6).

Simulations have been performed with 2000 households, 20 consumption goods producers, 3 banks, and 1 investment goods producer. This is a quite small (constant) number of agents. We understand the computational effort to simulate a complex economic model like the one the authors proposed; at the same time, we have some doubts on the robustness of results emerging from simulations with a few agents. If the authors want to keep the computational scenario as the one described in Section 7, they should also provide simulation results with a larger number of agents (given that, as maintained by the authors on page 6, "the EURACE platform is designed to be scalable to a large number of agents"). In other words, the authors can continue to comment simulation results with the above number of agents only if model findings are not affected by 'scale effects'. Even in this case, simulations with larger numbers of agents should be presented in the paper.

The paper is about debt, deleveraging and business cycles. Given that an explicit analysis of the mechanisms of economic growth is not provided (indeed the paper does not analyse long run properties), maybe the time span (20 years) could be reduced. This is not a necessary revision. But the authors can consider the following *trade-off*: reducing the length of the time span so to increase the number of agents involved in the simulations (for the reasons explained above). In this way, the computational time to simulate the model should not increase very much.

A better explanation of the investment goods sector should be provided. For example, we are not convinced that this sector is less complex than the consumption goods one. Our impression is that thinks are the opposite. Can the authors theoretically or empirically justify this modelling choice? Moreover, the price of 'capital goods' is a mark-up on energy prices. So there are no labour costs in this sector. Given this setting, we do not understand the meaning of the following statement (in particular, the words in *italics*): "Capital goods producers employ energy and raw materials to produce capital goods *following a job production process*" (page 7).

As the recent (and the historical) experience demonstrates Central Banks have a relevant role in contrasting the effects of financial crises. So it is important to introduce a central bank in a model that analyses the financial distress due to deleveraging along the business cycle. However, the way the central bank acts in the model w are discussing is quite questionable.

The central bank provides liquidity to the banking sector (at the policy rate) according to the following mechanism: If a bank's liquidity stock becomes negative, then the central bank lends an amount of money to the bank to solve its liquidity problem. Now, banks tend to manage their liquidity on the interbank market. So, in the model the central bank seems to substitute the working of this financial market. But this is not the main problem. The major limitation with the operation of the central bank in the model is that it provides all the liquidity banks need to counteract their liquidity deficit (an 'infinite supply' of liquidity as explained at the beginning of Section 7). Does it mean that banks cannot fail? Maybe the answer is yes given that there are just 3 banks in the model. So, the suggestion is to increase the number of banks or, to keep the model as simple as possible, to consider a banking sector as a single actor (like the central bank and the government). We prefer the first of the two suggestions.

In a sense, the central bank always operates in a financial crisis scenario, providing liquidity to banks without limitations (on its own; there are instead the capital requirements inspired by Basel II). We are not convinced that the central bank's behaviour as assumed in the model is quite general either as a theory of central banking or to be maintained over a 20 years time span of simulations. The authors should carefully rethink the working of the central bank in the model. At least, they should provide a well founded theoretical or empirical explanation to support the behaviour they assumed. In other words, a theoretical or empirical justification for the chosen behavioural rule should be provided, trying to explain that the "passive" behaviour of the central bank is general enough, that is it has not a strong influence on model simulations.

Minor revisions

We suggest to put the last paragraph of Section 1 - from "The Eurace model has been implemented.." to "... over parallel computers" – in a footnote.

Is it the standard rule of cost minimisation used in 'Factors demand' section consistent with "bounded rationality" as the principle underlying agents' behavioural rules throughout the paper?