Referee Report
Macroeconomic Relaxation: Adjustment Processes of Hierarchical Economic Structures

The paper applies a new approach to macroeconomic modeling which is well-known in statistical physics – the linear response theory. It is shown that this theory yields *time-dependent* macroeconomic response following from complex microeconomic dynamics with *heterogeneous* agents. The paper provides a microeconomic foundation of the dynamics of macroeconomic observables without the notion of the representative utility-maximizing agent. It is demonstrated that a consequence of the heterogeneity of economic agents and delayed macroeconomic response are hierarchical economic structures. The approach is applied to the response of output to demand shocks. It is shown that exponential response functions are the result of a time-dependent change in the unemployment rate. Okun's law is therefore a natural consequence of this approach.

The paper can be recommended for publication in the E-journal Economics. Its contribution is significant. The main strength of the paper is the representation of an alternative approach to the standard microeconomic foundation of macroeconomics, or New Keynesian theory where utility maximization and homogeneous agents are assumed. One weakness of the paper is its readability. It is not self-explanatory and therefore difficult to understand. For example, to understand the time correlation formalism presented in Section 2.4, you must study secondary literature, in particular Balakrishnan (1978). Moreover, the introduction of the paper does not contain an economic literature overview. It should be mentioned that methods of statistical physics have already been successfully applied in the theory of financial and security markets. It should further be discussed (and not only mentioned) that the heterogeneity approach is crucial for economic policy design. Are there any conflicts with the famous Lucas critique?

The mathematical analysis contains a mistake. If the concept of anelastic output is defined by (see p. 8)

$$Y^{an}(t) = \kappa\xi \tag{1}$$

and if the internal variable ξ is the employment rate ($\xi = 1 - u$), then obviously

$$Y^{an}(t) = \kappa(1-u) \tag{2}$$

But according to equation (17)

$$Y^{an}(t)/D = \kappa(1-u) \tag{3}$$

where D is demand and therefore

$$Y^{an}(t) = \kappa(1-u)D = \kappa\xi D \tag{4}$$

which is a contradiction to the definition (1) if $D \neq 1$. The internal variable ξ satisfies the differential equation (14) with the solution

$$\xi(t) = \overline{\xi}(1 - e^{-\eta t}) \tag{5}$$

where the equilibrium value $\overline{\xi}$ is given by (cf. (13))

$$\overline{\xi} = \mu D \tag{6}$$

Then, we can also write

$$Y^{an}(t)/D = \kappa\overline{\xi}(1 - e^{-\eta t}) \tag{7}$$

On the other hand, the example on page 11 yields the equation (cf. (29))

$$Y^{an}(t)/D = \kappa(1 - e^{-\eta t}) \tag{8}$$

which is only consistent with (7) if $\overline{\xi} = 1$ or $\mu D = 1$. If $\xi = 1 - u$, we also have

$$\overline{\xi} = 1 - \overline{u} \tag{9}$$

so that (3) and (5) imply

$$Y^{an}(t)/D = \kappa\overline{\xi}(1 - e^{-\eta t}) = \kappa(1 - \overline{u})(1 - e^{-\eta t}) \tag{10}$$

which is the RHS of equation (17). Equation (6) then implies

$$Y^{an}(t)/D = \kappa\mu D(1 - e^{-\eta t}) \tag{11}$$

and therefore

$$Y^{an}(t) = \kappa\mu D^2(1 - e^{-\eta t}) \tag{12}$$

while from (1) we get

$$Y^{an}(t) = \kappa\mu D(1 - e^{-\eta t}) \tag{13}$$

(12) and (13) are only equivalent if $D = 1$.