Response to Referee Report 2 on "The E-monetary Theory" for *E*conomics: The Open-Access, Open-Assessment E-Journal

I thank the referee for reading my work and providing thoughtful and fair comments on it. Below I will outline how I would respond to the referee 2's suggestions:

Referee (Major comments):

1. Part 1 "The mechanism driving the key results under quantitative easing (QE) is unclear.
What are the exact economic mechanisms that lead to QE being expansionary in the short-run and contractionary in the medium run? This does not become sufficiently clear in the paper. From the explanations given in the paper, the lower interbank bank rate would depress returns on capital leading to lower investment and consumption in the medium-run. This would result, combined with the gradual reduction of (gross) asset purchases, in a contraction in the endogenous money supply and period of deflation. Are the results that QE is only effective in the short-run by expanding the money supply, an artifact of mechanically keeping the interbank rate fixed for a long period of time? The separate contribution of QE and mechanically low interest rates to the results is unclear."

My Response: I am happy to follow the referee's suggestion to explain more the mechanism of my model in the revised version. I will use the change in the real interest rate to explain for the effect in short run and medium run. In the short run, QE (with private asset purchase) increases the money supply, lowering the real interest rate by mainly increasing the inflationary expectation.

In the medium run, the economy is contractionary because of the low nominal interest rate and the rise in the real interest rate. Unwinding QE is not the main reason for this decline. The mechanism follows the Fisher effect. After a while since the QE shock, the real interest rate (return on capital) will slowly increase, back to the long-run level. If the central bank keeps the nominal rate at zero and the liquidity premium does not change much, the demand for ZMDs will decline, as the real return on ZMDs is much lower than the real return on capital. As a result of that, the total endogenous money supply will decline and deflation must realize to ensure the equilibrium. During the episode when the real interest rate increases, the consumption and investment decline. The economy also contracts because of the price distortion when price is much lower from the target level.

The contribution of QE and mechanically low interest rate to the result

is difficult to separate due to the complicate interaction between nominal interest rate and money supply. My model starts from the steady state where the central bank controls the interbank rate by changing the level of reserves. In this regime, there is no separation between interest rate and money supply. However, in the regime when the central bank controls the interbank rate by IOR, there is a separation between them.

1. Part 2 "Adding to the confusion is the fact that it is unclear what policies are compared in Figure 4. What scenario is considered under "Taylor" as indicated in the legend? Is it the one described in Figure 3? This would mean that in this scenario the interbank rate is not mechanically kept fixed for 100 quarters. A clearer and more systematic analysis is needed, which is discussed in the next bullet point."

My Response: The referee is completely right that "Taylor" in the Figure 4 is the policy rule in the Figure 3. I will change the legend in the Figure 3 to make it consistent with the Figure 4. In the Taylor Rule, the interbank rate is not mechanically fixed for 100 quarter (Figure 3a). I will add the nominal rate path of the Taylor Rule (Figure 3a) to the Figure 4a.

2. "The analysis is incomplete. To completely understand the effects of QE, the following analysis is warranted:
-Step 1: What is the role of an effective lower bound on the interbank rate in the model economy? Figure 3 studies a mild recession in which the interbank bank remains unconstrained. I would suggest to construct a construct a scenario, triggered by a large, persistent capital constraint shock, that would lead to an endogenously binding interbank rate for a certain period of time. A "lower-for-longer" policy could be introduced by an interest rate peg.
-Step 2: Study a large contractionary capital constraint shock with and without QE
-Step 3: Study different scales of QE
-Step 4: Study different fade-out horizons for QE. Does the effect of QE depend on the persistence of the process for asset purchases relative to the number of periods at the lower bound?"

My Response: I am happy to follow the referee suggestion to conduct experiments on studying different scales of QE. However, studying an interest rate policy without QE to understand the role of an effective lower bound on the interbank rate might be addressed in a different model. An interest rate policy at the lower bound in my model could only be understood if we know the dynamics of reserves (QE or unwinding QE). That is the reason why in the Figure 3, my lower bound for interbank rate is higher than IOR. If my lower bound for interbank rate is IOR, the monetary policy is incomplete without knowing how the level of reserves will change. That is also the key difference between my model and the New

Keynesian literature. The latter one is more suitable for analyzing the monetary policy with only interest rate targeting.

3. Part 1 "The impulse responses in Figure 4 look very unusual.
The impulse responses for output, consumption, ZMDs and inflation have an unusual shape. One obvious explanation is that it is not possible to find a unique rational expectations solution for this model. The convergence to steady state is achieved by construction. This can be particularly seen for the real balances of ZMDs and output. The solution algorithm assumes that the model is back at its steady state in the last period (here, 300). However, it seems that ZMDs and output have diverged rather than converged in the periods before. What generates the unusual behavior in the variables, showing no clear pattern in the first 150 periods? It needs to be clarified whether the source of the behavior is multiplicity of equilibria, non-existence of a model solution or numerical issues going back to the algorithm.
Otherwise, it is not clear to which extent the results are really reliable. Since Figure 4 represent one of the key results of this paper, this is a major concern."

My Response: I will definitely put the problem of determinacy in the new "Discussion" section because it is an important issue. I will provide my code and detailed documents for the numerical methods in the main journal website with the final version. The figure 4 might not be a typical picture of an impulse response function on the monetary policy. However, if we think the figure is the combination of the New Keynesian model in the short run and the Fisherian model in the long run, everything starts making sense.

My model guarantees the uniqueness of the steady state under some conditions. By numerical methods, I also show that there is a perfect foresight solution for a system of equations that shares many features with reality. However, the limitation of my model is that it does not have a theoretical proof to show the uniqueness of this transition path. Hence, the multiplicity of equilibria is possible. I will clearly state this limitation in the discussion and hope that future research can address this issue.

3. Part 2 "Furthermore, the scale of QE seems very large, resulting in an increase of reserves by 700%. One argument for this approach is the fact that the reserve constraint would no longer be binding in this case. More intuition for this approach is warranted. Would QE have an effects at all if the reserve constraint is still binding? Furthermore, the interest rate peg is unusually long, reaching 25 years."

My Response: This is an interesting and important point that I will definitely put into

the Discussion section. When reserves increase by 700%, the ZMDs will also increase by 700% if the reserve requirement is still binding. This is clearly impossible as the level of bank loans are restricted by exogenous borrowing constraint. As a result of that, the only feasible scenario is that the reserve requirement becomes not binding, matching with what happened in Japan, US and Europe. In fact, in my numerical method, I never impose an unbinding scenario in the solution.

The interest rate peg for 25 years is unusually long as it takes a long time for the central bank returns to the lean balance sheet. It matches with the monetary policy in the last 10 years (at least with ECB and Bank of Japan). I will definitely put this point into the discussion.

4. "Examine the role of banks.
In the model framework, banks are effectively modeled as consumers, seeking to maximize an infinite stream of utility from a consumption good. This way, banks' demand directly affect the real economy and influencing prices and inflation. This contrasts established approaches in the literature that model bank as financial intermediaries (e.g. Gertler and Karadi (2011,2013)).
It would be interesting to understand whether differences in monetary policy transmission compared to the New Keynesian model can be attributed to the special role of banks. One approach would be to show to which extend proposed model nests the standard New Keynesian model in the absence of any financial frictions."

My Response: I am happy to put this point into the discussion section in my paper. Gertler and Karadi (2011, 2013) use an intelligent setup by using a family structure with two types of agents (bankers and workers) whose types could be switched. Basically, they could keep the representative-agent setup and model banks as financial intermediaries.

In my model, banks do not play a role of intermediary, but rather special financial institutions that can create inside money under regulations. Banks also directly affect the economy (even though their consumption only accounts 1% of total output in my model). A model nested both functions of banks will be very interesting, but it is a very challenging task to achieve. The beginning point to achieve that should be the family structure of Gerler and Karadi, which is very interesting but beyond the scope of my paper.

Minor Concerns

Bullet point The quality of the graphs and tables and the presentation of the models need to be improved.
For the tables, it would be advisable to clearly show the balance sheets

for banks and the central banks. This way it is easier for the reader to understand the money market and the transactions that are undertaken in the model economy. The legends of the figures (particulary, Figures 2, 3 and 4) have typos or partially completely unclear. In some cases, there is no explanation provided in the paper, e.g. "Taylor" in Figure 4. Furthermore, the presentation of the model should be further improved. The variable (tilde) x_t in Section 3.2 was never introduced (it is most likely shares of wholesale firms, x_t). A figure showing the relationships between private sector, banks and the central bank would be very useful.

My Response: I will fix the legends of my figures and explain in detail the meaning of each legend. I will also fix the notation in the section 3.2. For the tables and figures of balance sheet, I will use as much as possible to illustrate the balance sheet of each agent and the transactions in the economy.