Reply to the referees

First of all, we are grateful to the three referees that carefully revised our paper pointing out some of its weaknesses and giving us some useful suggestions that we took into account in this new version of the paper.

From a general point of view, we tried to clarify the objectives of our investigation, along with the methodology used in order to reach these objectives. We also explained the model with more details when needed and when suggested by a referee. We performed a new set of simulations with many different seeds in order to present a more robust statistical analysis. We added some plots and tables to give a more comprehensive explanation of the achieved results. Some new references have been added to better contextualize our work. Finally we revised the English style and we formatted our text, tables and figures in order to improve the readability of the paper.

In particular, we have added table 8 and table 9 showing cross-correlations between percentage variations of private sector money endowment, GDP and price level. We added some explicit information about the average number of bankruptcies in table 10, and we have included simulation paths for both QE and FT policy strategies. Moreover, in the interpretation of simulation results we have tried to point out in a more clear and extensive way the differences between the FT and the QE case.

In the following we present a detailed list of paper modifications. We divide this section in three parts, one per referee, in order to discuss their remarks and to show the consequential adjustments of the paper.

Referee 1 (anonymous)

Referee 1 divides its revision in two parts: some formal suggestions and five substantial suggestions with related comments.

Concerning the formal suggestions, that regard mainly style and formatting problems, we found them useful and we took them entirely into consideration in the new version of the paper. It is not worth going into further details with reference to this part, the referee can find its observations incorporated in the body of the paper.

Regarding the substantial comments of the referee, we report them with a related discussion.

A) *The variability of output and prices is determined by the increasing stock of money in the economy. In general dividends payment means many money, the agents in the system are richer, so that means arising production, reduction unemployment and following the traditional theory more inflation. These are trivial conclusions.*

   The mechanism described by the referee is correct but it does not take into account other key reasons that determine variations of macro variables like firms credit strategy, firms' bankruptcies, and central bank monetary policy. In particular, the agent-based approach can be very fruitful in modeling credit relationship, being able to fully take into account decentralized markets, credit interlinkages and the aggregate effects of firms barnkruptcy cascades. On the contrary, traditional analytical modeling approach based on the representative agent paradigm are usually unable to deal with these important real outcomes. We have also modified consistently the part of "computational experiments", trying to explain these mechanisms in a more extensive and detailed way. Moreover, our conclusions concerning the birth of business cycles and the variation of their amplitude in relation to the percentage of paid dividends show that the increasing stock of money in the system has different effects according to the nature of this new money (fiat money or credit money). In this sense we think that our conclusion should not be considered trivial.

B) *The authors conclude that this fact is the source of endogenous fluctuations. The higher monetary endowment due also to the dividends payment produce an increasing of GDP, because this means that agents use this money to buy more goods, so an increase of real demand. The consideration of authors about the fact that "....higher demand that not necessarily translates into a higher real demand...", is not true at all. See Blanchard Macroeconomics 2006 to follow the adjustment mechanism.*

   We agree that a higher monetary endowment can produce an increasing of GDP, however our work mainly shows that it may be responsible not only of a higher growth rate but also of higher GDP fluctuations and economic variability, in particular when the higher monetary endowment is given by credit money injected in the system and then firms debt load becomes high. On the other hand, when the central bank activates the mechanism of quantitave easing, the new money does not produce bankruptcies chains and GDP variability is lower. In the long run, however, the positive effects of QE are less evident. Regarding the consequences of a higher nominal demand, we actually have been somewhat unclear in our expression, and we tried to amend it in the new version of the paper distinguishing between short run and long run.

C) *Eurace is presented as a fully integrated macroeconomy because considers the real market, the financial market and the public sector. Which is the novelty? If we consider the IS-LM model and AS-AD model*

they are based on the same hypothesis. Which are the differences with respect to macroeconometric models like DRI, COMPACT, EPA and so on (see Blanchard 2006)

The novelty of the EURACE simulator is not only the presence of a real market, a financial market and the public sector in the same model, but also resides in the completeness of the model, that incorporates all the main economic decisions of all the actors in every market (decisions based on the wide use of empirically documented behavioural rules). EURACE is dynamically complete in the sense that it specifies all real and financial stocks and flows, allowing the upward aggregation from the micro-specifications to the macroeconomic variables of interest. EURACE is probably by far the largest and most complete agent-based model developed in the world to date, and we think that it actually represents a scientific novelty in the field of economic modeling. As a consequence it is worth noting that the EURACE model is definitely different from aggregate IS-LM and AS-AD models, which are just very stylized aggregate macroeconomic flow models, without neither an equity market nor a credit sector, with the consequent endogenous creation of credit money. EURACE is also significantly different from macro econometric models because it does not make use of any ad hoc aggregate macroeconometric relationship but it is based on a bottom-up modeling of realistic agents' behaviors and their consequent natural aggregation by means of decentralized markets and direct interactions to form general macroeconomic outcomes.

D) *Moreover it is highlight that Eurace is agent based, but are not specified how are these agents (1000 households), how their behaviours are formalized. On page 3 the authors say that the modelling of agents behaviors and the modelling of markets protocols are empirically inspired by the real world, that's? just "...bounded rationality, limited information gathering and storage capacities, and limited computational capabilities of the economic agents..."? If yes, in which way these assumptions are formalized? It seems that this simulation platform is used just to manage the computational complexity (1000 households, 10 consumption goods, and so on...)*

Here we perfectly understand the criticism of the referee. It is due to the problem to explain the high number of behavioral rules of the model within the paper. Our choice has been to avoid these explications in order to redact a more compact and readable paper, referring to some other documents for further details. In particular, it is possible to find an extensive description of EURACE markets and agents in the "final activity report" of EURACE that has been cited in the paper and that is available in the EURACE website (www.eurace.org).

E) *The focus of this point is that money influences income and the credit money determines endogenous business cycle. On this point I would suggest the following readings o look an eyes the work of Friedman, M. e A. Schwartz (1963), A Monetary History of the United States, 1867-1960, and Tobin, J. (1970), "Money and Income: Post Hoc Ergo Propter Hoc?",Quarterly Journal of Economics, no. 2, 301-17. Moreover, any considerations have been made about the labour income, that's in which way contributes to define the household wealth, and about households saving considering that in their balance sheet there are equity shares. How are they bought? Using only the dividends paid by firms?*

The readings suggested by the referee are certainly extremely interesting, and give useful insights on the debate about how money supply influences income. We think that our paper is contributing to that debate (especially after the significant changes we made in this revised version) using an innovative approach that permits to consider a bunch of multiple effects of an

high money supply, among which there is also the effect on wage inflation (see table 6). Concerning the question about households participation to the financial market, we added some explanations in paragraph 1.6 of the paper, where the functioning of the financial market is explained. We can resume it here, saying that households take their saving/consumption decisions according to a buffer stock theory rule (as explained in section 1.5) trying to smooth consumption along time. This decision depends on their total wealth and on their income (both labor income and financial income, i.e., dividends or bond coupons). Therefore, households may decide to keep their savings in their bank account or to invest them buying government bonds or firms stocks. Again, a much more detailed explanation can be found in the "EURACE final activity report", available in the EURACE website (www.eurace.org).