

Dear Sir/Madam,

We really appreciate your valuable comments. Following your insightful suggestions, we have made some critical revisions to the manuscript in order to strengthen our arguments. Next, we will respond to specific suggestions point by point.

1. **“... with a reference to the traditional fractional reserve theory of banking. Rather than rejecting this approach, as do Werner and Mcleay et al., it seems that the author simply wish to amend it, by making the multiplier a function of what happens with debt repayment.”**

In this paper, our focus is not on how money multiplier is determined, let alone how it is related to debt repayment. You are right that we should not seriously refer to the traditional fractional reserve theory of banking, which seems we are standing at the point against how the real economy works and also against the theory of credit creation.

2. **“On page 10, of their paper, the authors affirm that: ‘The commercial bank could only lend out its excess reserves to the traders, so the amount of loanable funds depends on the gap between the amount of reserves initially issued by the central bank and the required reserves, which could be obtained by multiplying the actual volume of deposits and the required ratio’. This would then mean that the causality goes from reserves to deposits and credits, and thus this reverses the causality as described by Werner and McLeay and several other heterodox authors.”**

Actually, we do understand the two misconceptions about credit creation theory according to McLeay et al, 2014. In financial intermediary theory of banking, banks can lend out the deposits that savers place with them to borrowers. In this view, banks have to collect deposits as their loanable funds, so the causality goes from deposits to loans from this perspective. On the other hand, according to fractional reserve theory of banking, there is an assumed constant ratio of broad money to base money, and the central bank can control the quantity of deposits in the economy by controlling the quantity of reserves, which are then “multiplied up” to a much greater amount of deposits. In this view, the causality goes from reserves to deposits. From the beginning of introduction, we have admitted credit creation theory of banking which have been advocated by Werner and Mcleay et al., as we have argued that once a bank grants a loan to a borrower, both money and debt are created simultaneously, which are like two sides of the same coin.

In the set-up of our model, we simply adopt the representation that money supply is a product of the money multiplier and the base money. This is an expedient way for what we were truly concerned in this work are money and debt circulations instead of money creation. Given the initial settings, the system would eventually attain a stable

state, in which both the aggregate amount of money and that of loans remain constants, whatever the kinetic path how these two stocks are reached. Once the artificial economy gets to the equilibrium, the money circulation and debt circulation can then be demonstrated.

Indeed, the assumption that the actual volume of deposits is a product of quantity of reserves and the required ratio may lead the readers to be confused about our true viewpoints. According to your suggestion, we have revised several paragraphs in the manuscript. First of all, we delete the representation of money supply but present it as a summation of base money and aggregate debt, as shown below:

“In the credit market, the commercial bank acts as the credit supplier. Once the bank grants a loan to a borrower, both money and debt are created. As a result, both the assets and liabilities of the bank expand simultaneously with the same amount. For the borrower, the credit money is his wealth and the loan is his debt, both resulting from the process of credit creation, and being exactly equal to each other. In general, the aggregate amount of money ( $M$ ), is usually expressed as the summation of the quantity of based money ( $M_0$ ), and that of aggregate debt ( $D$ ), which is given by  
$$M = M_0 + D.$$
”

Secondly, the supply of credit is not solely controlled by the central bank any longer, however, we assume that both the reserve requirement policy and prudential regulations would restrict bank lending process. As shown in the flowchart below, we presume that the loanable funds of the bank can be constituted by both its repayment and its capability to create credit, the mathematical expression of loanable funds is that:

$$F(t) = D_{max} - D(t) + R(t),$$

where  $D_{max}$  represents the maximum amount of debt the bank can extend. The corresponding paragraphs are shown below:

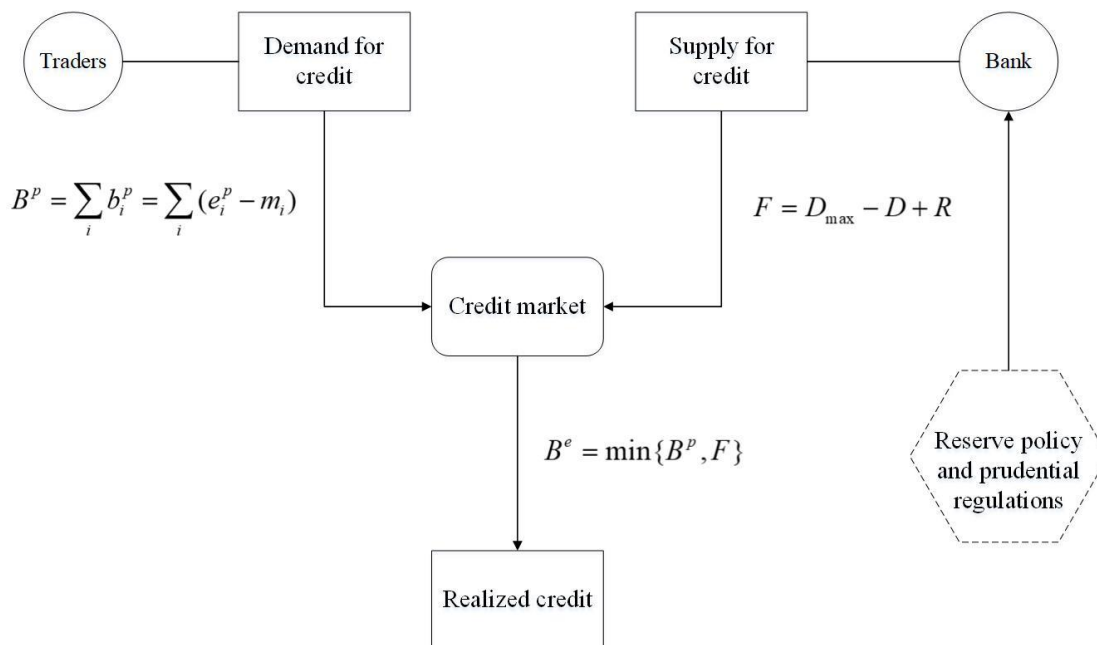
“The quantity of loanable funds of the commercial bank is determined both by its repayment and its capability to create credit, which is regulated by both the central bank and the banking supervisory authorities through reserve policy or prudential requirements.”

“In other words, the commercial bank is able to create credit as long as it is demanded, leading to an expansion of its balance sheet on both sides. However, such expansion cannot occur unrestrictedly, there are a few regulations introduced by the central bank and the banking supervisory authorities. ... ..In fact, all these regulations limit the capability of a commercial bank in credit creation. Once the bank expands its balance sheet to an extent, even one additional unit of debt would break the regulatory requirements and thus lead the bank to be severely punished. In our model, we transform these requirements imposed on individual banks into a corresponding constraint of maximum amount of debt over the representative

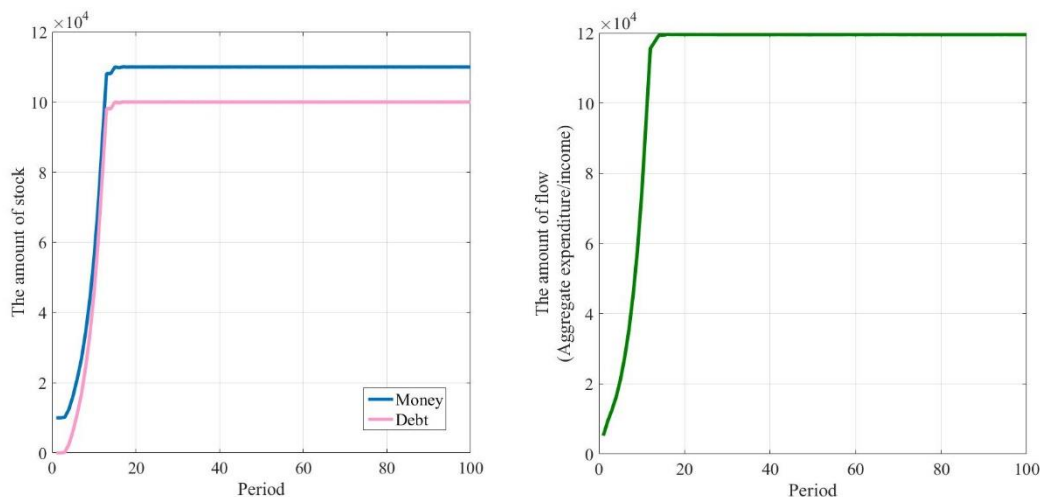
commercial bank,  $D_{max}$ , so the loanable funds of the bank at period  $t$ ,  $F(t)$ , can be given by

$$F(t) = D_{max} - D(t) + R(t),$$

where  $R(t)$  is the repayment of loans of the bank at period  $t$ .”



Based on these revisions of assumptions, the dynamic processes of stocks and flows are different from the original version, so we replotted Figs. 4 and 5, given as below. However, once the aggregate amounts of money and loans keep constant, the



processes of money circulation and debt circulation will run independently, the distributions of holding times of money and debt remain unchanged and how they depend on the parameters does not change neither.

3. “The rest of the paper presents an exercise in money velocity, with an agent-based model that appears to be rather rudimentary compared to existing models, and hence it does not appear to be truly innovative.”

The first innovation of our work, we believe, is the introduction of the concept of “debt circulation”. Since the term of money circulation was coined, the existence of debt circulation has not been recognized so far. We believe that this concept is very helpful in understanding the mechanism of debt crisis and its impact on macroeconomics. Based on model presented in *Xiong, W., Fu, H., and Wang, Y. (2017)*, we present the microfoundations of both money and debt circulations by focusing on the holding times of money and debt respectively. By collecting the data of both holding times of money and debt in our simulations, we demonstrate that both distributions take exponential form, and their corresponding velocities can be obtained through fitting method, which, we believe, is another innovation of this work. Additionally, the ultimate argument of this work is that, not only money circulation constitutes aggregate income from the monetary perspective as the traditional *quantity theory of money* says, but also debt circulation can play as an essential component of aggregate income parallel to that of money. From both theoretical analysis and simulations, we demonstrate that the aggregate income can be presented as both money flows generated from money stock and debt flows generated from debt stock. As this restatement of *quantity theory of money* implies that,

$$PY = MV_m + DV_d.$$

This equation is obviously different from the original one, in which debt has never been involved.