We appreciate the reviewer's deliberate comments on our work. Thanks to these helpful insights, we have made corresponding revisions to the manuscript in order to be clearer about our arguments. Next, we will respond to specific suggestions point by point.

1. **"The topic of the paper is highly relevant. Financial regulation aims at influencing the incentives of banks and other financial intermediaries in carrying out maturity, liquidity and risk transformation. Since when they provide credit to the economy, banks also create inside money, the paper asks to which extent the LCR, the leverage ratio and the risk-based capital requirements limit the lending and money creation process."**

   We appreciate the reviewer's acknowledgement of the importance of the question and topic discussed in this paper. The principal purpose of the current paper is to pay a revisit to the money creation process from an alternative perspective other than the traditional fractional reserve theory, and provide a theoretical explanation of why and how prudential regulations in the Basel III accord may have a constraining effect on the banking system's capacity of money creation.

   To serve this purpose, we employ a simplified yet bank-centred and stock-flow consistent framework to model the money creation process, and investigate the impacts of three Basel III regulations both when being imposed alone and when taking effect simultaneously. Despite the fact that our model is rather parsimonious, we attempt to contribute to the existing literature in the following aspects:

   1) With respect to the understanding of the money creation process, we add to the thriving literature that rethinks the classic theory of fractional reserve banking by emphasizing the causation that the flow of lending(repayments) creates(destroys) the stocks of deposits and loans simultaneously, and by fulfilling the knowledge gap about the differences in the money creation process resulted from the introduction of new prudential regulations proposed in the Basel III accord[1]. Our results innovatively show that unlike the old days when the reserve requirement is the only constraint for money creation and the money multiplier is regarded as the inverse of the required reserve ratio in its simplest form, the imposition of the new Basel regulations can bring about conditions that the expansion of the monetary base could not boost the broad money aggregate[2] and that the money multiplier could consequently fall with increased monetary base[3].

   2) In terms of the literature related to the macroeconomic impact of the Basel III accord, our focus on money supply, which corresponds to the liability side of the banking system, complements the more extensive discussions about its impacts on the credit supply, which is related to the asset side of the banking system. Moreover, we take into accounts three different prudential regulations, i.e. the CAR, LR and LCR regulations, and investigate the standalone and collective impacts of these regulations, which makes our analysis more comprehensive than works that only consider one or two capital based prudential regulation, and thus is an echo of Halden (2012)'s call for more efforts into the investigation of the multi-polar regulatory framework and the interaction of different prudential instruments.

[1] In the existing literature, studies that rethink the process money creation, for instance, Moore (1988); Palley (1994); Disyatat (2011); Keen (2011); McLeay et al. (2014); Werner (2014), Carpenter and Demiralp (2012), have not sufficiently addressed the impacts of the Basel III accord, while studies that examine the impact of the Basel III accord, seldom takes into account its impact on the money creation process. To the best of our knowledge, a few exceptions that have the same target as ours, namely investigate the impact of Basel regulations on money creation, can be found in Honda (2004); Panagopoulos（2010）; Li et al (2017). More details about their works are given in the revised manuscript.

[2] This refers to the case where the bank is constrained by the LR regulation, with the level of bank capital being considered as exogenously given because of financial frictions in the bank capital market.

[3] This corresponds to the cases for all prudential regulations in our analysis. More explanations are given in the following pages of this response as well as in the manuscript.

3) Compared with works that employ more complicated model setting, such as the DSGE model or the full-scale SFC model, we put forward a paired-down theoretical model based on the work of Li et al (2017)[4]. The main purpose of the model is to provide a straightforward illustration of the money creation process and to analyse the most direct impacts of the new Basel regulations. Although the conclusions given in this paper are qualitative rather than quantitative, we hope they could be inspirations for further empirical studies or be easily integrated into full-scale SFC models.

In order to be clearer about the intention and contribution of the current work, we made the following revisions in the manuscript[5]:

Although a profusion of efforts have been made in evaluating and predicting the macroeconomic impact of the Basel III accord, this paper attempts to add to this literature in several aspects. To begin with, we examine the influences of Basel III regulations on the liability side (money) of the commercial bank's balance sheet, so as to complement the more extensive discussions about its effects on the bank's asset side (credit). On the one hand, it is well demonstrated by existing literature that the bank's credit supply will be negatively affected by the tightening of capital related prudential requirement, either in terms of decreased growth rate or increased price, especially in the short term [2].On the other hand, much less attention is paid to the changes in the bank's liability side, i.e. the money supply, as the result of the variations in the regulatory constraints faced by the commercial bank. To the best of our knowledge, a few exceptions can be found in Honda (2004); Panagopoulos (2010); Li et al. (2017). Specifically, Honda (2004) extends the textbook money creation model to incorporate the impact of capital based regulations and demonstrates that the transmission of monetary shocks via the asset (the credit channel) and the commercial bank's liability side (the money channel) are two different mechanisms. Panagopoulos (2010) investigates empirically the influence of Basel II type CAR regulation on Greek banking system and concludes that its money creation process can be favorably explained by the Post Keynesian Structuralism theory of endogenous money. Li et al. (2017) examines the role of the latest LCR regulation in money creation and finds that such regulatory constraint might lead to a reduction in the money multiplier.

Furthermore, we contribute to the understandings about the interactions among different prudential requirements by taking into account the simultaneous imposition of multiple regulatory instruments. While the benefits of such multi-polar

[2] See VanHoose (2007); Peek and Rosengren (2010); Martynova (2015) for reviews of related studies.

[4] The difference between the current model and the model used in Li et al (2017) is explained in our response to the other reviewer and is listed in the footnote in Page 12 in the revised manuscript.

[5] Revisions in the manuscript in correspondence to this response are marked in orange, while the revisions related the other reviewers are marked in blue and the revisions inspired by the comments of the readers are given in red.

regulatory regime in addressing different types of risks and frictions are straightforward, there is considerable uncertainty about the collective consequences of multiple prudential regulations when being imposed at the same time(Haldane, 2015). Therefore, in response to the call of Haldane (2015) for more efforts in examining the complexity of multi-polar regulatory framework, this paper considers three prudential regulations in the Basel III accord, including the CAR, LCR and LR regulations. More specifically, we examine the role of these regulations in the money creation process by answering three questions. The first question is what determines the broad money supply and the corresponding money multiplier when each concerned regulation is taking effect alone. Second, when multiple regulations are imposed at the same time, which of them is the binding constraint that dictates the bank's ability to create money. Last but not least, since most prudential regulations are ratio controls of the items on bank balance sheets, it is also vital to know how the effective binding regulation and the corresponding money multiplier vary with changes in the structure of bank balance sheet in different economic conditions.

2. **"However, the paper is not able to provide a reliable answer to this question. The prudential regulation has the objective of eliminating (or reducing) the externalities created by financial intermediaries. Banks' supply of inside money is the result of a profit maximization problem and is determined by marginal returns and marginal costs of additional loans. The fact that in maximizing their profits banks do not take into account the costs that they may generate for the society in terms of financial instability justifies the introduction of regulatory constraints on banks' balance sheets: regulations reduce those externalities by increasing the marginal cost of lending (when the regulatory limit become binding for a bank).**

   But banks' cost of funding new loans is sensitive to the health of the underlying financial environment. In a general equilibrium perspective an economy that is more "financially resilient" may reduce the cost of funds and the cost of capital and relax endogenously regulatory constraints (see on this CGFS, 2015).

   Therefore, a general equilibrium approach is crucial in order to understand whether prudential regulations will play an important role in affecting banks' behaviours in the money creation process. "

   We thank the reviewer for pushing us to address the key question in this paper by adopting a general equilibrium approach, which admittedly, is an integrated description of the real economy, for it takes into account of more economic agents and macroeconomic causalities. Also, the reviewer is right in pointing out the possibility that more financial resilience may reduce the cost of funds for banks and thus relax the regulatory constraints.

   However, we would like to differ from the reviewer with respect to the opinion that the general equilibrium approach is the only pathway to study the role of prudential regulations in the money creation process. The current paper takes on a partial equilibrium approach, which centres on the behaviour of the commercial bank for it is regarded as the primary economic agent in the money creation process. We examine economic conditions where financial frictions exist and the efficient market hypothesis as well as the MM theorem are not applicable. In particular, the equilibrium for money creation discussed in this paper means that the commercial bank cannot create more loans or deposits under the constraint of the concerned Basel III regulations, because these regulations require the bank to hold a minimum level of credit base in proportion to the total amount of credit it creates, i.e. bank capital or high quality liquid assets (HQLA), but the bank cannot increase its holdings of

bank capital and HQLA at will for there are financial frictions in the market for bank capital and HQLA. In the market for HQLA, which mainly consists of government bonds and reserves, the central bank and the government are the monopoly suppliers of reserve and government bonds. Thus the amount of HQLA held at the banking system as a whole, is largely exogenously determined. Also, for individual banks, obtaining liquidity from the interbank market can be expensive and even infeasible during stressful times. As for the market of bank capital, due to the information asymmetry between the bank and its investors, increasing the amount of equity capital can be very costly for the bank and can also be unavailable in some cases. In other words, during the money creation process, while the we view the stocks of loans and deposits as endogenous variables and the stocks of HQLA and bank capital as exogenous variables, because the former are mainly determined by the behaviours of the commercial bank and the latter are more dependent on the decisions of other economic agents. Although we have not specifically modelled the actions and responses of other economic agents as an endogenous part of the model, this does not mean that the economic conditions we discuss are implausible cases. Moreover, since our major goal is to examine the potential constraining effects of concerned prudential regulations on money creation, it does not make much sense that we deviate from this goal by discussing conditions where these regulations do not make any difference for bank activities. In addition, our assumptions that these prudential regulations are binding constraints for banks are no much different from the assumption used in the textbook money creation model for the reserve requirement. The similarity of the assumptions in our model and that in the textbook money creation model makes it easier for the readers to understand what differences are brought about by the newly imposed prudential regulations. As for changes in the underlying financial environment, we account for this by illustrating the transitions of the effective binding regulation and the corresponding changes in the value of the money multiplier when the bank balance sheet structure varies in different economic conditions.

Lastly, we would like to mention that both the partial equilibrium approach as well as the assumption of exogenously given capital level are not our own invention but are actually commonly used in existing literature. For example, Table 1 provides some studies that are related to prudential regulations and are featured by the partial equilibrium approach and the exogenous capital assumption. In comparison with the general equilibrium approach, partial equilibrium models are often more straight forward and easy to follow, which are thus commonly used in situations where the focus is on the behaviour of specific economic agents, for instance, the commercial bank in the discussions of prudential regulations. Also, even though the general equilibrium approach is considered as a more comprehensive description of the economy, it is important to be aware of its shortcomings that the link between the assumption and the results are hard to follow, that the model is often solved as a black box with the intertwined macroeconomic causalities are buried by complicated equations, and that it is difficult to evaluate or compare the results of different models. While the general equilibrium approach is necessary for quantitative analysis, the goal of the current paper is to provide a qualitative analysis for the potential influences of the new Basel III regulations on the money creation process.

Table 1 Examples of studies that adopt the partial equilibrium approach and exogenous capital assumption

Title	**Bank capital**	**Concerned prudential regulation**	**Type of model**
Kopecky and VanHoose(2004a)	Exogenous in the short run and endogenous in the long run	CAR and LR	Static and partial equilibrium model

Kopecky and VanHoose(2004b)	Exogenous in the short run and endogenous in the long run	CAR	Static and partial equilibrium model
Honda (2004)	Exogenous	CAR and LR	An extension of the textbook money creation model (partial equilibrium)
Chami and Cosimano (2010)	Endogenous	CAR in the form of Basel I	Dynamic and partial equilibrium model
Zicchino (2006)	Endogenous	CAR in the form of Basel I and II	Dynamic and partial equilibrium model
Furfine (2001)	Endogenous	CAR in the form of Basel I and II;LR	Dynamic and partial equilibrium model
Van den Heuvel (2006a)	Endogenous	CAR in the form of Basel I	Dynamic and partial equilibrium model
Jorge (2009)	Endogenous	CAR in the form of Basel I	Two period partial equilibrium model
Thankor (1996)	Exogenous	CAR in the form of Basel I	Dynamic and partial equilibrium model with multiple competing banks
Kashyap and Stein (1994)	Exogenous	CAR in the form of Basel I	Static and partial equilibrium model
Li et al (2017)	Not applicable	LCR	Dynamic and partial equilibrium model

To sum up, we thank the reviewer's comments and we will consider in our future work the suggestion of extending the current model to a general equilibrium framework. For now, we think our model is sufficient to address our question. Some corresponding revisions are made in the revised manuscript to clarify the intentions of employing the current theoretical framework, which are shown as follows:

In order to answer these questions, we model the money creation process and focus on the behaviors of the commercial bank in a simplified stock-flow consistent framework that respects both the accounting principle and the law of motion between stock and flow variables. To simplify analysis, we assume that the level of bank capital and high quality liquid assets are exogenously given, while the level of loans and deposits are endogenously determined in the money creation process. Also, we abstract from the rest of the economy by assuming that the loan demand is higher than the loan supply and that the interest rate of lending is always profitable for the bank. Compared with works that attempt to assess or predict the more general macroeconomic impact of Basel III in terms of social welfare or aggregate output (e.g. Slovik and Cournède (2011); Allen et al. (2012); Angelini et al. (2015); Miles et al. (2013); Yan et al. (2012); Quinaz and Curto (2016)), we study a shorter logic chain that involves much less intertwined macroeconomic causalities[3] and correspondingly organize our analysis in a paired-down theoretical framework that intends to give qualitative rather than quantitative conclusions about the constraining effects of prudential regulations on money creation. The merits of such approach are that the reasoning process is straightforward and easy to follow, and that the theoretical implications of new Basel regulations in the

161 money creation process can be directly compared with those of the classical reserve
162 requirement.

[3] For instance, we do not consider the interplay between banks and the rest of the economy, including the impact of the former's credit and money supply on the latter's aggregate demand, as well as the changes in the latter's investment in bank liabilities.

3. **"The paper, instead, analyzes this issue employing a stock-flow model that imposes highly ad-hoc (and in some cases unreliable) assumptions on the behavior of balance sheets items. As an example, in the model it is assumed a positive correlation between reserves and government bonds in banks' balance sheets (G=g*R). As a result the authors claim that "under all three regulations the money multiplier responds negatively to the increase of monetary base". But this is just because the authors do not take into account how the central bank operates when it "increases" the monetary base. It is sufficient to think about quantitative easing (QE) in order to understand that this relation is not necessarily true: to the extent that the central bank purchases government bonds held by banks, reserves increases and government bonds decrease in banks' balance sheets. In this case the LCR, the leverage ratio and the risk-based capital are all unchanged. But also in normal times, the central bank "injects" reserves in the monetary system either through outright purchases (the central bank purchases government bonds in exchange of reserves) or through collateralized loans (the central bank lend reserves in exchange of a collateral): the relation between reserves and bonds in the banks' balance sheet may well be negative.**

In addition there are many inconsistencies between the assumptions and the results of the analysis. For example, in describing the model the authors assume that Government bonds (G) and Capital (C) are constant functions of the amount of reserves (R). But when the authors compute the derivative of the outside money with respect to reserves, this assumption disappears"

As an example, let's take equation (32), which states that $M = \frac{4(R+G)}{\mu r_{LCR}}$ and $\frac{\partial M}{\partial R} = \frac{4}{\mu r_{LCR}}$. But since the authors assume that $G = gR$ shouldn't be $\frac{\partial M}{\partial R} = \frac{4(1+g)}{\mu r_{LCR}}$?

Similarly, in equation (33) the money multiplier is defined as $m = \frac{4(1+g)}{\mu r_{LCR}}$, and therefore the money multiplier does not depend on the amount of reserves. But when taking the derivative it comes out (equation 35) that $\frac{\partial m}{\partial R} < 0$.

We apologize for the misunderstandings caused by the expressions of Equation (7) G=g*R and (8) C=c*R, in the previous version of the manuscript. To better present our assumption, we delete these two expressions in the revised manuscript and rephrase Equation (7) and (8) to be G(t)=G and C(t)=C, and indicate specifically that the variables of G, C, R are assumed to be exogenously given and always positive. Corresponding expressions with g and c are also corrected.

Our original intention for introducing g=R/R and c=C/R is to simplify the expression for the multiplier rather than assuming a positive relation between R and G or R and C. And our results for all partial derivatives are derived based on the assumption that R, G, C are all exogenous variables. To be more specific, in the example given by the reviewer, when taking the partial derivative of Equation (32) $M = \frac{4(R+G)}{\mu r_{LCR}}$ with respect to R, because G and C are kept as constant, the result is $\frac{\partial M}{\partial R} = \frac{4}{\mu r_{LCR}}$. Similarly, the partial derivative of Equation (33) $m = \frac{4(1+\frac{G}{R})}{\mu r_{LCR}}$ with respect to R is also derived based on the assumption that G and C are constant after the shock to R, so that $\frac{\partial m}{\partial R} = -\frac{4G}{\mu r_{LCR} R^2} < 0$.

Furthermore, we would like to explain why the amount of government bonds held by the commercial bank does not necessarily fall when the central bank increases the monetary base. To begin with, this is simply not what we can observe in the reality. As shown in Figure 1, there is no straightforward countermovement relation between the monetary base (bank reserves + currency in circulation) and the treasury and agency securities held at all commercial banks (government bonds). To obtain more prudent conclusions, we perform two statistical tests to examine the empirical relation between the amount of government bonds (G) and the reserve balances (R) held by the commercial bank. We use the cash assets at all commercial banks as the proxy for R and the treasury and agency securities at all commercial banks as the proxy for G[6]. Data are documented in the official document of "H.8 Assets and Liabilities of Commercial Banks in the United States" and obtained from https://fred.stlouisfed.org/ . The time span is from 1973/1/1-2017/10/1, and the frequency is monthly. To remove the trend and make the time series stationary, we take the difference of the logarithmic values of the two variables, i.e. $\Delta \ln R$ and $\Delta \ln G$. The first test is to compute the Pearson's product-moment correlation of $\Delta \ln R$ and $\Delta \ln G$. We find that the correlation coefficient is 0.096, the t-statistics is 2.236, and the p-value for the null hypothesis of true correlation is 0.02574. This result indicates that the linear correlation between the two series is weak, and NOT negative. The second test is the granger causality test with the purpose of examining the inter-temporal relation between the two variables. The stationarity of the two series is confirmed by the ADF test and the lag length is set to be 1 and 9 based on the best lag given by the AIC, HQ, SC and FPE criteria (Table 2). As indicated by Table 3, NEITHER $\Delta \ln R$ NOR $\Delta \ln G$ granger causes each other. In other words, the inter-temporary association between the two time series is not statistically significant.

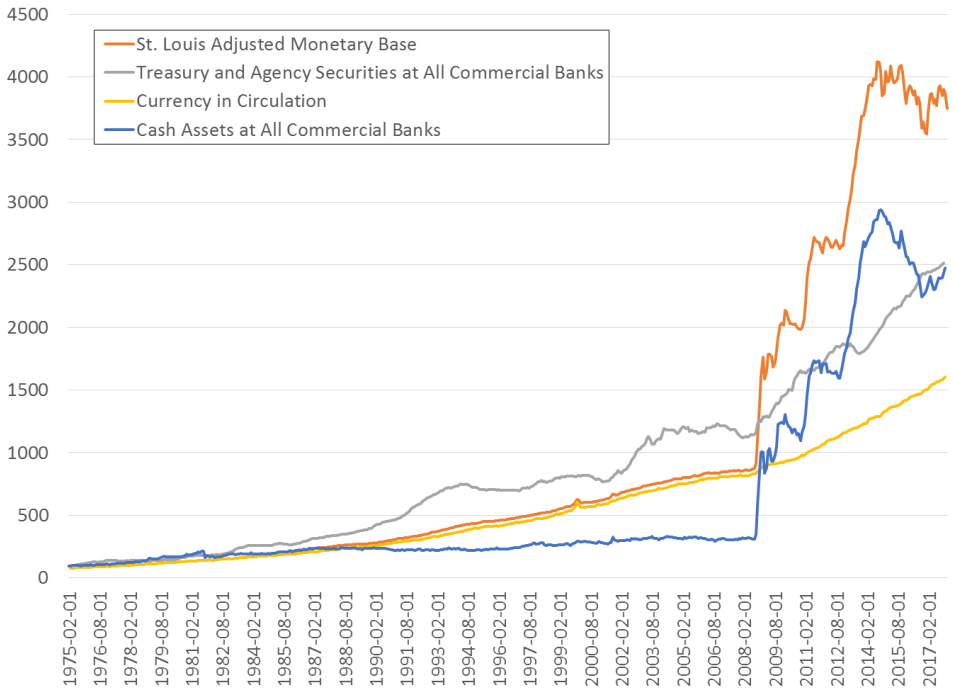

Figure 1 Historical data for the monetary base, its major components (currency in circulation and cash assets at all commercial banks) and the treasury and agency securities held at all commercial banks in the U.S. from 1973/1/1 to 2017/10/1. Data frequency: monthly. Data source: https://fred.stlouisfed.org/.

[6] The conclusions still hold if we use the St. Louis Adjusted Monetary Base as the proxy for R.

Table 2 Best lag length given by different selection criteria for ΔlnR and ΔlnG.

	AIC(n)	HQ(n)	SC(n)	FPE(n)
Best lag	**9**	**1**	**1**	**9**
1	-0.319	**-0.3**	**-0.27**	0.727
2	-0.315	-0.283	-0.234	0.73
3	-0.342	-0.298	-0.229	0.71
4	-0.342	-0.285	-0.196	0.71
5	-0.337	-0.268	-0.159	0.714
6	-0.332	-0.249	-0.121	0.718
7	-0.336	-0.241	-0.093	0.715
8	-0.338	-0.23	-0.062	0.713
9	**-0.348**	-0.228	-0.04	**0.706**
10	-0.342	-0.209	-0.002	0.710

Table 3 Results for the Granger Causality Test for ΔlnR and ΔlnG

Null hypothesis	Lag length	1	9
ΔlnR does not granger cause ΔlnG	F-statistics	0.52002	1.6543
	p-value	0.471	0.09568
ΔlnG does not granger cause ΔlnR	F-statistics	0.66684	0.41996
	p-value	0.4143	0.925

Second, to understand why R and G are not negatively correlated, it is necessary to take a more careful look at how exactly the central bank increases the monetary base through open market operations (OMOs)[7]. Depending on the goal and time frame, there are two types of OMOs: temporary OMOs and permeant OMOs. Temporary OMOs are implemented through repos or reverse repos and are used to address temporary reserve needs from the commercial bank or to help set the federal funds rate. Although such act will give rise to the countermovement of government bonds and monetary base, yet its nature is transitory and more importantly, its main goal is to adjust the interest rate rather than controlling the amount of monetary base. Thus its effects on the level of monetary base and government bonds are only temporary and often are negligible, especially in terms of affecting the money creation process. Permanent OMOs, on the other hand, are traditionally used to accommodate the trend growth of currency in circulation. In other words, this act results in a permanent expansion of the state credit, which requires a corresponding increase in the Fed's holdings of government bonds. However, an increase of the Fed's holdings of government bonds is not equivalent to a decrease in the commercial bank's holdings of government bonds, but could be realized by a corresponding increase in the total issuance of government bonds (Figure 2). Moreover, the Quantitative Easing policy (QE) mentioned by the reviewer is also a type of permanent OMO, which results in non-temporary expansion of the central bank's balance sheet. But unlike conventional permanent OMOs, a large part of QE during the 2007-9 crisis is implemented by purchasing Mortgage-backed Securities (MBS), which are NOT the usual risk-free and highly liquid

[7] For more information, see https://www.federalreserve.gov/monetarypolicy/bst_openmarketops.htm or https://www.newyorkfed.org/aboutthefed/fedpoint/fed32.html.

government bonds. As for collateralized loans from the central bank to the commercial bank, the assets that are used as collateral for this loan will not be taken from the commercial bank. Instead, this act will cause the expansion of both sides of the commercial bank's balance sheet.

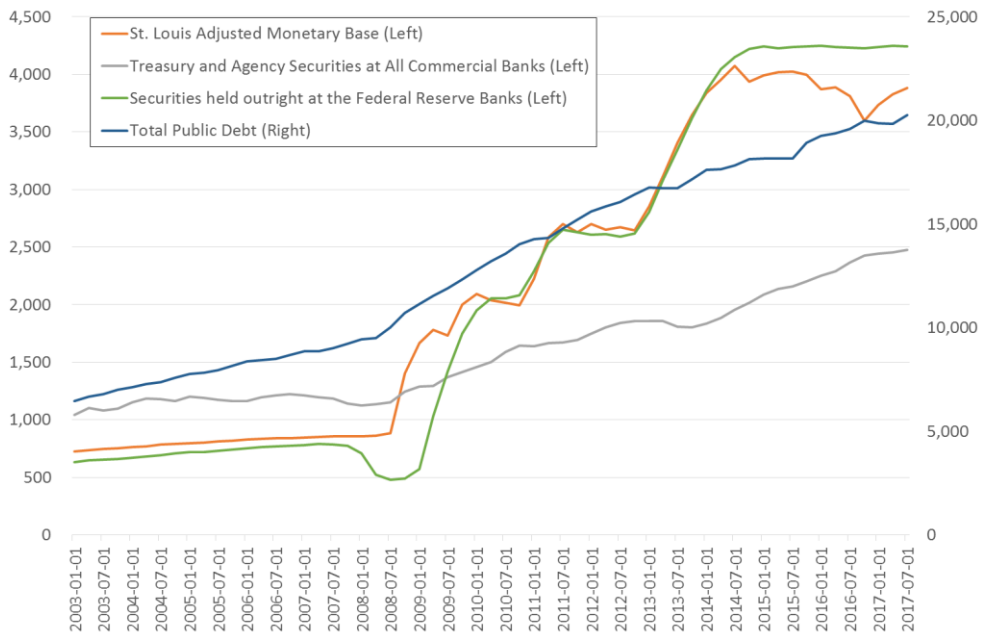

Figure 2 Historical data for the monetary base, treasury and agency securities at all commercial banks, securities held outright at the Federal Reserve Banks and the total public debt in the U.S. from 2003/01/01-2017/07/01. Data frequency: quarterly. Data source: https://fred.stlouisfed.org/.

For these reasons, we find it imprudent to assume a definite negative relation between the amount of government bonds held by the commercial bank and that of the monetary base. Since the main purpose of our model is to demonstrate the dynamics of the money creation process, where the commercial bank create deposits by making loans, we regard R, G and C as exogenous variables because they are not the changed by the actions of bank lending (LF) and loan repayment (RP). In other words, we try to demonstrate how the level of loans (L) and deposits (D) are determined by the dynamics of the bank lending and the loan repayment flow, given the level of R, G and C as well as the concerned prudential requirements. Because different prudential requirements set different constraints on the bank's balance sheet items, we derive at corresponding expressions for the maximum amount of loans and deposits the bank can create without breaching the prudential regulation. Then, we examine when there is a shock to the monetary base (MB), what would be most direct effects on the broad money aggregate (M) and the money multiplier (m). Because there are no direct and definite associations between the change in the monetary base and the government bonds and bank capital, we regard these variables as constant when we discuss the response of M and m to changes in MB.

Corresponding changes in the revised manuscript are marked in orange and listed as follows:

The stocks of reserves, government bonds and bank capital are assumed to be always positive and exogenously given. In other words,

$$R(t) = R, \tag{6}$$

$$G(t) = G, \tag{7}$$

$$C(t) = C. \tag{8}$$

Correspondingly, based on Eqs. 6,7 and 8, the money multiplier m, defined as the ratio of the broad money supply and monetary base, is then given by

$$m = \frac{M}{MB} = 1 + \frac{G}{R} - \frac{C}{R} + \frac{L_{max}}{R}. \tag{21}$$

$$m = \frac{4}{\mu r_{LCR}}(1 + \frac{G}{R}). \tag{31}$$

In order to examine the response of the bank's money creation capacity to changes in the monetary base under the constraint of the LCR regulation, ceteris paribus, we can take the partial derivatives of Equations 30 and 31 with respect to the level of bank reserves, the results of which are given as follows:

$$m = \frac{(1 + \frac{G}{R})(1 + \theta - r_{LCR}) + r_{LCR}\frac{C}{R}}{r_{LCR}[\mu(1 + \theta) - 1]} \tag{37}$$

we can rewrite the conditions of $IF^* \geq 0.75OF^*$ and $IF^* < 0.75OF^*$ as a function of μ, θ, R, G, C following the manipulations shown in B. In specific, the two conditions are respectively equivalent to $\mu \leq \frac{4(1+\frac{G}{R})}{(3\theta+3+r_{LCR})(1+\frac{G}{R})-\frac{C}{R}r_{LCR}}$ and $\mu > \frac{4(1+\frac{G}{R})}{(3\theta+3+r_{LCR})(1+\frac{G}{R})-\frac{C}{R}r_{LCR}}$.

In summary, the full expressions for the equilibrium money supply and money multiplier are respectively given by

$$M_{LCR} = \begin{cases} \frac{4(R+G)}{\mu r_{LCR}}, & \mu \leq \frac{4(1+\frac{G}{R})}{(3\theta+3+r_{LCR})(1+\frac{G}{R})-\frac{C}{R}r_{LCR}}; \\ \frac{(R+G)(1+\theta-r_{LCR})+r_{LCR}C}{r_{LCR}[\mu(1+\theta)-1]}, & \mu > \frac{4(1+\frac{G}{R})}{(3\theta+3+r_{LCR})(1+\frac{G}{R})-\frac{C}{R}r_{LCR}}, \end{cases} \tag{42}$$

$$m_{LCR} = \begin{cases} \frac{4(1+\frac{G}{R})}{\mu r_{LCR}}, & \mu \leq \frac{4(1+\frac{G}{R})}{(3\theta+3+r_{LCR})(1+\frac{G}{R})-\frac{C}{R}r_{LCR}}; \\ \frac{(1+\frac{G}{R})(1+\theta-r_{LCR})+r_{LCR}\frac{C}{R}}{r_{LCR}[\mu(1+\theta)-1]}, & \mu > \frac{4(1+\frac{G}{R})}{(3\theta+3+r_{LCR})(1+\frac{G}{R})-\frac{C}{R}r_{LCR}}. \end{cases} \tag{43}$$

$$m_{CAR} = 1 + \frac{G}{R} + (\frac{1}{\gamma r_{CAR}} - 1)\frac{C}{R} \tag{48}$$

$$m_{LR} = (\frac{1}{r_{LR}} - 1)\frac{C}{R} \tag{54}$$

sponding to either two regulations take the same value. For the sake of simplicity, we denote the ratio of government bonds to reserves as $g = \frac{G}{R}$ and the ratio of bank capital to reserves as $c = \frac{C}{R}$. In specific, the boundary condition between the LCR and CAR regulations is given by

4. **"Finally, in the paper there are many statements that seem more personal opinions than results obtained from reliable theoretical models or empirical analyses. For example, the authors claim that "we argue that in contrast to the attenuation of the reserve requirement as a constraint on bank lending, prudential regulations have played an increasingly important role in affecting bank behaviors in the money creation process." Or "with the answer to these questions we will be able to understand why the money multiplier collapses after massive expansion of the monetary base". These claims are quite surprising (and not proved in the paper) especially if referred to the past. I would say that two other factors may explain the reduction in the money multiplier observed after the outbreak of the global financial crisis: on the one side, according to the literature on financial cycles and on debt super cycles, demand factors and deleveraging (see for example Borio, 2012 and Lo and Rogoff, 2015) are the main explanation of the decrease of inside money; on the other side, the increase of the outside money is the result of unconventional monetary policies aimed at reducing long term interest rates**

(Quantitative easing in main advanced economies) and liquidity premiums in some specific markets (SMP and LTROs in the euro area, ABS purchases by the Fed and the ECB). The combination of these two explanations are sufficient to explain why the velocity of circulation (and, therefore, the money multiplier) has decreased."

First of all, it is noteworthy that the money multiplier and the concept of the velocity of circulation are two different concepts and the trends of the two variables cannot be used to represent each other (as shown in Figure 3). By definition, the money multiplier denotes the ratio of the broad money aggregate and the monetary base while the velocity of circulation is the frequency at which money (deposits and cash) participates in economic transactions and is often calculated as the ratio of the nominal GDP and the broad money aggregate (v=PY/M). The money multiplier mainly reflects the extent to which the banking system magnifies the base money through the process of money creation, while the determination process of the money velocity is more complicated that involves the transaction behaviors of the nonbank sector.

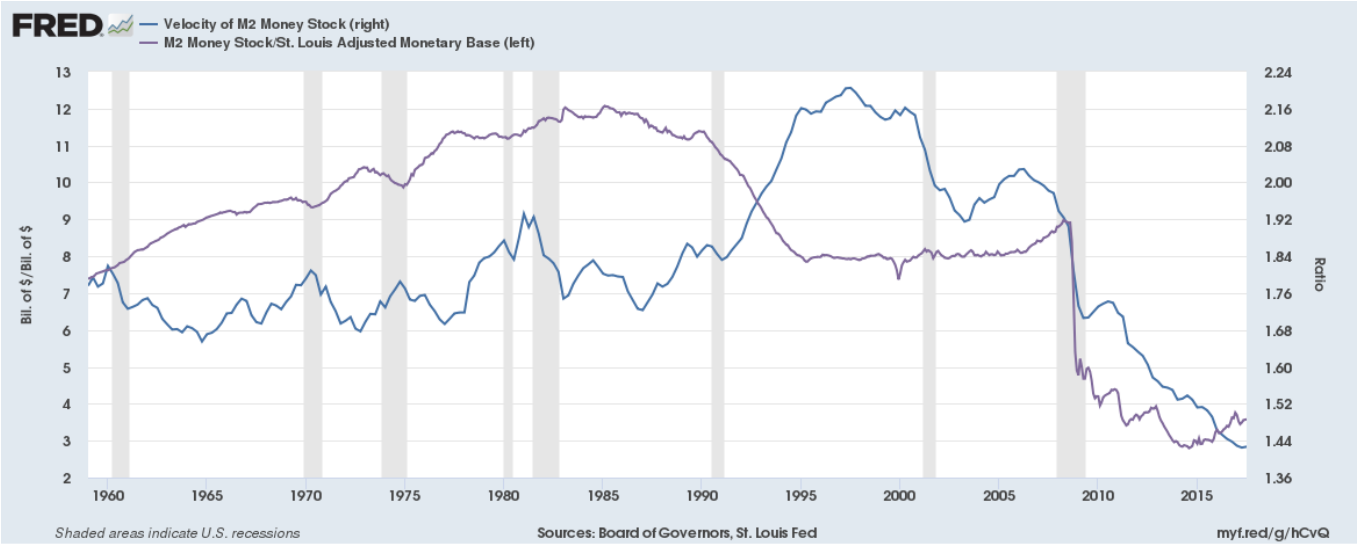

Figure 3 Historical data of the M2 money multiplier and the velocity of M2 money stock in the United States

As for the author's criticism against our claims of the attenuated role of the reserve requirement on bank activities, we have laid out reasons for why this is the case in modern banking practice and similar arguments from other studies as the support for this claim. First, there are many countries that do not have the reserve requirement, such as Canada and the UK. Second, for countries like the U.S. that do retain this requirement, the development of the financial market make it easier for bank to substitute deposits that bear reserve requirement with non-reservable deposits, and to raise temporary reserves from the interbank market, so as to meet the reserve requirement that is implemented with a time lag. In contrast, prudential regulations have become more stringent and complicated, which therefore, play an increasingly important role in constraining bank lending. More specifically, the LCR regulation is based on the amount of HQLA in relation with the net cash outflow within 30 days under stressed conditions, which reduces the opportunistic practices of commercial bank relying on the interbank market to obtain short-term liquidity. Similarly, the CAR and the LR regulations require the bank to have their own skin in the game by asking for a minimum amount of capital in proportion of the total risk exposure/amount of its assets. With the worldwide endorsement of the Basel III accord, we find it not surprising that the imposition of these prudential regulations could have a constraining effect on bank activities. And in the second section, we have also listed empirical studies that identify the negative impact of tightening of the capital requirement on bank lending.

As for the arguments related to the collapse of the money multiplier after the financial crisis, we have no intention in saying that the implementation of more complicated and stringent prudential regulations is the only reason for the reduction of the money multiplier. And it is not the primary goal of this paper to explain this specific economic phenomenon. The reason why we think that our analysis could have implications for understanding the collapse of the money multiplier is that our results show that when the bank is capital or liquidity constrained, the expansion of the monetary base can lead to the reduction of the money multiplier. This is because the bank cannot raise more liquidity or capital buffer to guard against the risks associated with increased bank loans. Although our conclusions are derived based on specific prudential regulations exogenously imposed on the bank, the liquidity/capital constraints may also rise endogenously from the financial market, i.e. the bank itself may find it necessary to hold more HQLA and bank capital to avoid bankruptcy given its weakened asset and liability structure during financial stress. This is in consistent with the inclination to deleverage during the crisis mentioned by the reviewer. And we appreciate and agree with the reviewer's comments on that there are other reasons that may be responsible for the collapse of the money multiplier. We have not discussed the roles of interest rate and the demand side factors in this paper, which would be an interesting topic for future discussion. We are sorry if some sentence seems a little bit overstated for the reviewer. In order to straighten our claims, we modified the corresponding sentence in the revised manuscript and add the discussions about the reasons for the collapse of the money multiplier in the concluding remarks.

Corresponding revisions in the manuscript are listed as follows:

In other words, it can thus be implied that due to recent financial innovation and policy changes, the reserve requirement is playing a less important role in constraining the money creation process. Nevertheless, in contrast to the attenuation of the reserve requirement as a regulatory constraint for commercial banks, prudential regulations become much more stringent and complicated after the recent financial crisis, which renders an non-negligible impact on bank activities (McLeay et al., 2014). Building on the previous rethinkings and criticisms of the FRT, this paper aims to explore why and how prudential regulations could have a constraining effect on the commercial bank's ability to create money, which therefore provides a new insight into the classical money creation process. In particular, we study

ditions. ~~With the answers to these questions, we will be able to understand why the money multiplier collapses after the massive expansion of the monetary base and advise policy makers on how to boost the banking system's credit creation capacity under multiple prudential regulations in different conditions.~~

macroeconomic impact of Basel III on economic growth. Also, some implications can be drawn from our results for the unusual collapse of the money multiplier during the recent financial crisis[13]. In particular, we have demonstrated economic conditions where the money multiplier falls with the expansion of the monetary base because the commercial bank is capital or liquidity constrained. Although our conclusions are derived based on specific prudential regulations put forward in the Basel III accord and imposed exogenously on the bank, the liquidity/capital constraints may also rise endogenously from the financial market. In other words, one potential explanation for the sluggish response of bank lending to the expansion of the monetary base is that more lending will add to the bank's risk exposure that requires more liquidity and capital buffers to prevent from bankruptcy, whereas obtaining more liquidity and capital buffers are expensive or difficult for the bank due to the weakening of the underlying economic environment.

Lastly, although the simplicity of the model is considered as a merit in the current analysis, it is also important to be aware of its limitations, including the assumption of representative bank, abstractions of interest rate and non-passive response of other economic entities. An extension of the model into more general stock-flow consistent models incorporating heterogeneous agents and more serious data calibration would be a fruitful possibility for future research.

[13] See Goodhart et al. (2016) for more related discussions on this issue.

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