Scientific Research Publishing

Theoretical Economics Letters, 2024, 14, 1405-1440
https://www.scirp.org/journal/tel
ISSN Online: 2162-2086
ISSN Print: 2162-2078

The Strategic Interaction between US and China on Safe Asset Issuance

Rongyu Wang[1,2]

[1]School of Economics, The University of Edinburgh, Edinburgh, United Kingdom
[2]Information Research Institute, Qilu University of Technology (Shandong Academy of Sciences), Jinan, China
Email: v1rwang7@ed.ac.uk

How to cite this paper: Wang, R. Y. (2024). The Strategic Interaction between US and China on Safe Asset Issuance. *Theoretical Economics Letters, 14,* 1405-1440.
https://doi.org/10.4236/tel.2024.144068

Received: May 2, 2024
Accepted: July 12, 2024
Published: July 15, 2024

Abstract

I study the strategic interaction between US and China in the international monetary system and international price system from the Western perspective. Their behavior differs due to the different structures of their devaluation costs. The structure of devaluation costs of US determines that it exhibits strategic complements while the structure of devaluation costs of China determines that it exhibits strategic substitutes. It is also found that the asymmetry between the safe asset issuance of US and China at present can be explained by the devaluation costs and the probability that both countries experience disaster states. A general principle found in this paper is that what the US does hurting (benefiting) itself benefits (hurts) China, while what China does hurting (benefiting) itself hurts (benefits) US. Therefore, subject to the devaluation cost structure proposed in the model, the attempt to replace USD with RMB is not beneficial to China.

Keywords

Dollar, Renminbi, International Monetary System, International Price System, Mixture of Strategic Substitutes and Strategic Complements, Devaluation Costs, China, US

1. Introduction

In both media and academia, more and more people expect China will be capable of challenging the dominant status of US in the international monetary system and in the international price system, e.g., Farhi and Maggiori (2019) and Tass News Agency (2023). Although that day is still far away, people have begun seriously considering the prospect of a rivalry between dollar (USD) and renminbi (RMB). For example, Farhi and Maggiori (2019) study the reaction of

USD facing the challenge of RMB as an emerging challenger of the hegemon status of USD in the international monetary system and international price system. In my paper, I focus on the complete strategic interaction between USD and RMB. Although not fully-fledged yet, as a relatively weaker player in the international monetary system and the international price system, China has commenced internationalizing RMB, which inevitably reduces the share of USD in world economy, by issuing safe assets globally. Note that the challenge of China towards US is comprehensive and the currency rivalry is part of it from the Western perspective. Such comprehensive rivalry has no counterpart yet in the present world affairs. Therefore, in my paper, I focus on the strategic interaction between two countries, US and China, for safe asset issuance. The paper features how the strategic interaction between the two currencies propels or alleviates the pressure of devaluation of each currency. Like Farhi and Maggiori (2018), the devaluation of either USD or RMB is viewed as a partial default of the currency which will lead the respective country trapped in Triffin dilemma. Therefore, to some extent, the strategic forces due to the rivalry between the two currencies shape their destinies respectively.

From the Western perspective, according to the two countries' performances until today in economic and financial affairs, US often shows willingness to cooperate with the China, while on the contrary China often launches challenges towards the US. However, from the Chinese perspective, China actively advocates a win-win cooperation with the US but the US often ignores China's kindness. The purpose of the paper is to account for the strategic interaction between USD and RMB from the Western perspective. By adjusting the parameter specifications, my model can also account for the strategic interaction between USD and RMB from the Chinese perspective. Because the main stream views on the strategic interaction between USD and RMB in Western countries are more stylized and systemic, which can better support the corresponding parameter specification, therefore in this paper I study the strategic interaction of USD and RMB from the Western perspective.

For both economic interests and political purposes, China has begun actively providing loans denominated in RMB and other financial assets denominated in RMB such as Chinese sovereign bonds worldwide (Gete & Melkadze, 2020). It can be expected that as Chinese economy continues growing, these financial assets or safe assets will be issued on a much larger scale. In the 1970s, due to the excessive issuance of USD, the US was trapped in Triffin dilemma and the Bretton Woods system collapsed. As in Caballero, Farhi and Gourinchas (2017), the excessive issuance of safe assets can also incur the devaluation of the domestic currency, which is called the new version of Triffin dilemma, or Triffin event in Farhi and Maggiori (2019). Hence, China can also experience Triffin event for excessive issuance of its safe asset. As mentioned, the status quo of US and China in terms of the volume of safe asset issuance is highly asymmetric. However, the criterion to measure whether Chinese safe asset issuance is excessive is different from its counterpart for the US. A much smaller amount of Chinese safe asset issuance compared with its counterpart of US can also incur Triffin event for China.

The research of this paper is based on Farhi and Maggiori (2019), which is an application of the theory proposed by Farhi and Maggiori (2018). Except that in this paper I study the equilibrium of the game rather than only studying the properties of the best response of US in Farhi and Maggiori (2019), my model features the different costs a currency devaluation incurs to the country. Devaluing a currency can ease the fiscal pressure of a country, but it also requires the country to sacrifice some benefits so that it can achieve the purpose of easing fiscal pressure. If a country devalues its own currency, it will strike its own economy, which is the cost towards itself, and it will also benefit its opponent, which is the cost paid to its rival. Think about the costs incurred to US if it devalues USD in the strategic interaction with China. If the USD were devalued and US fell into Triffin dilemma, the US would immediately fall into debt trouble due to its high domestic debt, whose impact would ultimately incur contagion to its entire economy. This is the devaluation cost incurred towards US itself. Besides, the world would lose confidence towards USD, which would correspondingly make China gain the world's confidence towards RMB. These are the benefits that US loses to China in international monetary system and international price system. Such a cost is what the US pays to China for a USD devaluation. Likewise, if RMB were devalued and China fell into Triffin dilemma, it would severely blow Chinese economy so that it could even bring the collapse of the Chinese economy as the country is expected to still heavily depend on debt and trade to fuel its economy, which is the devaluation cost incurred towards China itself. Besides, the devalued RMB will strengthen people's confidence in USD, and hence China loses the benefits of international monetary system and international price system to US. Such a cost is what China pays to US for a RMB devaluation. In this paper, I fine-grinned the devaluation costs and find that the relationship among these costs plays a deterministic role in determining the equilibrium.

In our context, strategic complements describe a situation where the more safe assets US issues to RoW, the greater China's payoff is, while strategic substitutes describe a situation where the more safe assets China issues to RoW, the less US payoff is. Given the specific setting as described above, I find that the US exhibits strategic complements even though it faces the Chinese challenge in the international monetary system and in the international price system, while China exhibits strategic substitutes as it launches the challenge towards the US in the international monetary system and in the international price system. However, no matter whether they exhibit strategic complements or strategic substitutes, their exorbitant privileges are always eroded due to the increasing issuance of the opponent country's safe assets. Further, the model shows that to account for the present asymmetry between the safe asset issuance between US and China, the devaluation costs and the probability that disaster states happening for US and China play critical roles.

When discussing the impact of the share of one currency used in pricing and invoicing in a country and the impact of currency depreciation on the likelihood of a country experiencing Triffin event, the rising share of pricing and invoicing of RMB in US tends to make US more likely to confront the Triffin dilemma, while to make China less likely to confront the Triffin dilemma. Such a property is determined by the strategic substitutes of Chinese issuance behavior. But the rising share of pricing and invoicing of USD in China tends to make both China and US more likely to confront the Triffin dilemma, which is determined by strategic complements of US issuance behavior.

Likewise, due to the strategic substitutes of Chinese issuance behavior, the greater expected degree of devaluing USD is, the less likely China experiences a Trffin event, while the US is more likely to experience a Triffin event. However, due to the strategic complements of US issuance behavior, the greater expected degree of devaluing RMB is, the more likely the US experiences a Triffin event, and also China is more likely to experience a Triffin event.

This paper is the first one to systematically study the strategic interaction between US and China on safe asset issuance, while Farhi and Maggiori (2019) is the first paper to study the reaction of the US facing China's challenge on safe asset issuance. The paper also features the mixture of strategic complements and strategic substitutes. There are a few papers in game theory to study games with both strategic complements and strategic substitutes, e.g., Karp, Lee and Mason (2007) and Hoffmann and Sabarwal (2019). However, unlike the existing research where either all players exhibit strategic complements or all players exhibit strategic substitutes, in my model, one player exhibits strategic complements and one player exhibits strategic substitutes. In addition, the existing literature that studies games with both strategic substitutes and strategic complements seldom focuses on the application of these games, but I directly focus on the application of the mixture of strategic complements and strategic substitutes in game theory. These contributions make this paper innovative in both fields of international monetary system and game theory.

The paper is organized as follows. Section 2 presents the model. Section 3 derives the best response functions. Section 4 studies the properties of the best response functions of the model. Section 5 exhibits the equilibrium. Section 6 explains the present asymmetry between US and China in terms of the volume of safe asset issuance. Section 7 studies how the share of one currency used in pricing and invoicing in one country affects both countries' debt issuance. Section 8 studies how the extent of devaluation of one currency affects the likelihood that both countries experience a Triffin event. Section 9 concludes the paper.

2. The Model

The model has two periods $t = 0$ and $t = 1$. Three classes of agents interplay within the game: US, China and the rest of the world (RoW), which includes sovereign and private international investors and consumers worldwide. In a deeply globalized world with close trade ties, it is hard to expect significant differences in consumption. Therefore, it can be approximately regarded that the basket consumed worldwide are largely the same with slight differences. That is, US-produced consumption bundle traded in the world market and China-produced consumption bundle in the world market are similar. US and China respectively produce a single final composite good with a continuum of intermediate goods. At $t=0$, US and China are endowed with resources w^{US} and w^{CN} respectively, while RoW is endowed with w^{*}.

I consider four representative assets in my model: a risky real asset in perfectly elastic supply provided in US market, a risky real asset in perfectly elastic supply provided in Chinese market, a USD-denominated nominal bond issued by the US, and an RMB-denominated nominal bond issued by China. With generality, I normalize the relevant parameters to make expected return of both risky real assets equal to each other. The expected return of both risky real assets is denoted by $\bar{R}^{r}$.

There are two states of the world at $t=1$ for US and China respectively, indexed by H^{US} and L^{US}, and H^{CN} and L^{CN}. The L^{US} state, referred to as a disaster state of US, occurs with probability $\lambda^{US}\in(0,1)$. Likewise, the state L^{CN}, a disaster state of China, occurs with probability $\lambda^{CN}\in(0,1)$. For simplicity, I specify that the expected return of both risky assets issued in US markets and Chinese markets are same, and it is given by $\bar{R}^{r}$.

At time $t=1$, supposing a disaster has occurred for US, US may devalue USD vis-a-vis RMB. The exchange rate between USD and RMB is normalized at 1 at $t=0$, and takes either of the following values at $t=1$: $e^{US}\in\{1,e_{L}^{US}\}$, where e^{US} is the RMB price of a dollar. Thus, $e_{L}^{US}<1$ corresponds to a depreciation of the USD. Supposing USD is devalued, the US pays fixed costs τ_{US}^{US} and τ_{US}^{CN} respectively, where the total cost the US pays is $\tau^{US}=\frac{b^{US}\tau_{US}^{US}+b^{CN}\tau_{US}^{CN}}{b^{US}+b^{CN}}$. τ_{US}^{US} is the devaluation cost the US pays to itself. For example, if the US devalues USD so that the country experiences Triffin event, the US economy will suffer and accordingly the loss of real GDP can reflect τ_{US}^{US}. τ_{US}^{CN} is the devaluation cost the US pays to China. For example, if the US devalues USD and hence experiences Triffin event, the US will lose the benefits it enjoys now in international monetary system and international price system, and the lost benefits in international monetary system will be transferred to China. Such transfers, if measured in real value, can reflect τ_{US}^{CN}. τ_{US}^{US} and τ_{US}^{CN} are real values which are not measured by monetary unit. That is why when I raise the examples, I use terms such as real GDP or transfers measured in real value.

b^{US} represents the bond issuance in USD value issued by US and b^{CN} represents the bond issuance in RMB value issued by China. I will elaborate the meaning of b^{US} and b^{CN} in detail in the following. Because the b^{US} and b^{CN} considered here are bond issuance within the US safety zone and Chinese safety zone respectively, therefore according to the normalized exchange rate, the USD value of bond issuance by China also equals b^{CN}. Hence, the monetary units of the denominator and numerator in the weights $\frac{b^{US}}{b^{US}+b^{CN}}$ and $\frac{b^{CN}}{b^{US}+b^{CN}}$ are canceled and these weights are not affected by monetary units.

Likewise, at time $t=1$, supposing a disaster has occurred for China, China may devalue RMB vis-a-vis USD. The exchange rate between RMB and USD is normalized at 1 at $t=0$, and takes either of the following values at $t=1$: $e^{CN}\in\left\{1,e_L^{CN}\right\}$, where e^{CN} is the USD price of a RMB. Thus, $e_L^{CN}<1$ corresponds to a depreciation of the RMB. Supposing RMB is devalued, China pays fixed costs τ_{CN}^{CN} and τ_{CN}^{US} respectively, where the total cost China pays is $\tau^{CN}=\frac{b^{CN}\tau_{CN}^{CN}+b^{US}\tau_{CN}^{US}}{b^{US}+b^{CN}}$. τ_{CN}^{CN} is the devaluation cost that China pays to itself. For example, if China devalues RMB so that the country experiences Triffin event, the Chinese economy will be severely suffered and without gigantic amount of resources devoted to save it, the situation of the economy will be even worse. Devoting gigantic/amount of resources to save economy has been frequently practiced by China, for example in the 1997 Asian Financial Crisis and the 2008 global economic crisis. Therefore, the ultimate costs due to the economic crisis caused by the currency devaluation, measured in real value, can reflect τ_{CN}^{CN}. τ_{CN}^{US} is the devaluation cost that China pays to US. For example, if China devalues RMB and hence experiences Triffin event, China will lose some benefits it enjoys now in international monetary system and international price system, and the lost benefits in international monetary system will be transferred to the US. Such transfers, if measured in real value, can reflect τ_{CN}^{US}. Like the devaluation costs of US, τ_{CN}^{CN} and τ_{CN}^{US} are also real values which are not measured by monetary unit.

Still, b^{US} represents the bond issuance in USD value issued by US and b^{CN} represents the bond issuance in RMB value issued by China. Also, because the b^{US} and b^{CN} considered here are bond issuance within the US safety zone and Chinese safety zone respectively, therefore according to the normalized exchange rate, the RMB value of bond issuance by US also equals b^{US}. Hence, for China, the monetary units of the denominator and numerator in the weights $\frac{b^{US}}{b^{US}+b^{CN}}$ and $\frac{b^{CN}}{b^{US}+b^{CN}}$ are also canceled and these weights are not affected by monetary units.

In this paper, the active monetary policy decisions by RoW are abstracted away, which helps emphasize the strategic interactions between US and China.

The US representative agent's preferences are given by: $C_0^{US}+\delta^{US}\mathbb{E}\left(C_1^{US}\right)$, and the Chinese representative agent's preferences are given by $C_0^{CN}+\delta^{CN}\mathbb{E}\left(C_1^{CN}\right)$, where δ^{US} and δ^{CN} are discount factors for US and China respectively. In order to ensure that each agent is indifferent between consumption at $t=0$ and $t=1$, I specify that $\delta^{US}=\delta^{CN}=\frac{1}{\bar{R}^r}$. In period 0, the US and China choose how many bonds b^{US} and b^{CN} to issue respectively. RoW demand for US bonds and Chinese bonds depends on whether these bonds are expected to be safe or risky, *i.e.* on whether USD or RMB are expected to depreciate in a disaster or not. Supposing US bonds are expected safe, then the demand for US bond is finitely elastic and given by

$$R^s\left(b^{US}\right)=\bar{R}^r-\gamma\left(w^*-b^{CN}-b^{US}\right) \tag{1}$$

where γ is the risk aversion coefficient of RoW. w^* is the real value of endowment of RoW. Although b^{US} represents the bond issuance in USD value issued by US and b^{CN} represents the bond issuance in RMB value issued by China, if the US bonds are considered safe, b^{US} also represents the real value of the debt issued by US (the amount of US debt issued by US). Likewise, if the Chinese bonds are considered safe, b^{CN} also represents the real value of the debt issued by China (the amount of Chinese debt issued by China). Here the US bonds are expected safe and the Chinese bonds are also considered safe.[1] Therefore, the b^{CN} and b^{US} in the above equation represents the real value of the bond issuance by China and US. Note that these bonds include both public and private safe bonds issued in respective countries, which follows Farhi and Maggiori (2018).

Supposing Chinese bonds are expected safe, then the demand for Chinese bond is finitely elastic and given by

$$R^s\left(b^{CN}\right)=\bar{R}^r-\gamma\left(w^*-b^{US}-b^{CN}\right) \tag{2}$$

where b^{CN} indicates the real value of the debt issued by China and b^{US} represents the real value of safe US debt issued by US. Again, these bonds include both public and private safe bonds issued in respective countries.

According to Farhi and Maggiori (2018), if US bonds or Chinese bonds are expected risky, then the demand for either type of bonds is infinitely elastic and the return rate on either type of bonds is the same as the return of the respective risky assets. Following Farhi and Maggiori (2019), I specify the risky asset return at bad states are $R_H^{r^{US}}=\frac{\bar{R}^r-\lambda^{US}R^{US}e_L^{US}}{1-\lambda^{US}}$ and $R_H^{r^{CN}}=\frac{\bar{R}^r-\lambda^{CN}R^{CN}e_L^{CN}}{1-\lambda^{CN}}$ respectively.

The production sectors in US and China consist of a continuum of measures one of firms that produce intermediate varieties respectively, denoted by $Y_t^{US}(j)$ and $Y_t^{CN}(j)$, and retail sectors respectively that bundle these varieties into the final consumption goods for each country:

[1]The actions that will be studied in the following parts of the paper will be focused on the safe debt issuance of both US and China. Therefore, in the safe debt return function of US, it is with generality that the Chinese bonds are considered safe. Likewise, in the safe debt return function of China, it is also with generality that the US bonds are considered safe.

$$Y_t^{US}=\left[\int_0^1 Y_t^{US}(j)^{\frac{\sigma^{US}-1}{\sigma^{US}}}\,\mathrm{d}j\right]^{\frac{\sigma^{US}}{\sigma^{US}-1}}$$

and

$$Y_t^{CN}=\left[\int_0^1 Y_t^{CN}(j)^{\frac{\sigma^{CN}-1}{\sigma^{CN}}}\,\mathrm{d}j\right]^{\frac{\sigma^{CN}}{\sigma^{CN}-1}}$$

where σ^{US} is the elasticity of substitution between intermediate variety *j* and *j'* produced in US, and σ^{CN} is the elasticity of substitution between intermediate variety *j* and *j'* produced in China. Note that in this paper I exclude the trivial cases where $\sigma^{US}=1$ and $\sigma^{CN}=1$. Therefore, throughout the paper, I focus on the cases where $\sigma^{US}\neq 1$ and $\sigma^{CN}\neq 1$.

Consequently, the demand functions for a firm's variety in US and China are given by

$$Y_t^{US}(j)=\left[\frac{P_t^{US}(j)}{P_t^{US}}\right]^{-\sigma^{US}} Y_t^{US} \tag{3}$$

where $P_t^{US}(j)$ is the price determined by US firm *j* and

$P_t^{US}=\left[\int_0^1 P_t^{US}(j)^{1-\sigma^{US}}\,\mathrm{d}j\right]^{\frac{1}{1-\sigma^{US}}}$ is the aggregate price index, where with generality, USD is used as numeraire, and

$$Y_t^{CN}(j)=\left[\frac{P_t^{CN}(j)}{P_t^{CN}}\right]^{-\sigma^{CN}} Y_t^{CN} \tag{4}$$

where $P_t^{CN}(j)$ is the price determined by Chinese firm *j* and

$P_t^{CN}=\left[\int_0^1 P_t^{CN}(j)^{1-\sigma^{CN}}\,\mathrm{d}j\right]^{\frac{1}{1-\sigma^{CN}}}$ is the aggregate price index, where with generality, RMB is used as the numeraire.

Because home bias is considered absent and the law of one price holds, P_t^{US} can be thought of as the world USD price of the US produced consumption bundle. Likewise, P_t^{CN} can be thought of as the world RMB price of the Chinese produced consumption bundle.

The production technologies in US and China are considered identical. They are $Y_t^{US}(j)=L_t^{US}(j)$ for US and $Y_t^{CN}(j)=L_t^{CN}(j)$ for China, where $L_t^{US}(j)$ is a US firm *j*'s demand for labor in US and $L_t^{CN}(j)$ is a Chinese firm *j*'s demand for labor in China. Labor is inelastically supplied in US and China respectively, where the total labor of US is given by $L^{US-Supply}$ and the total labor of China is given by $L^{CN-Supply}$.

In each country, there are some firms sticky in USD and the other firms are sticky in RMB. For US, I order firms in the interval $[0,1]$ such that for firms

$i \in [0, x]$, the prices are sticky in USD and for firms $i \in (x, 1]$, the prices are sticky in RMB. For China, I order firms in the interval $[0,1]$ such that for firms $i \in [0, z]$, the prices are sticky in USD and for firms $i \in (z, 1]$, the prices are sticky in RMB.

The US labor market clearing condition is

$$\int_0^1 Y_t^{US}(j)\,\mathrm{d}j = (1-x)Y_t^{US-RMB} + xY_t^{US-USD} = \int_0^1 L_t^{US}(j)\,\mathrm{d}j = L^{US-Supply} \tag{5}$$

where Y_t^{US-USD} is the output produced by the set of US USD-sticky firms and Y_t^{US-RMB} is the output produced by US RMB-sticky firms. With generality, these firms are uniformly distributed in US.

The Chinese labor market clearing condition is

$$\int_0^1 Y_t^{CN}(j)\,\mathrm{d}j = (1-z)Y_t^{CN-RMB} + zY_t^{CN-USD} = \int_0^1 L_t^{CN}(j)\,\mathrm{d}j = L^{CN-Supply} \tag{6}$$

where Y_t^{CN-USD} is the output produced by the set of Chinese USD-sticky firms and Y_t^{CN-RMB} is the output produced by Chinese RMB-sticky firms. Likewise, with generality, these firms are uniformly distributed in China.

At $t=1$, for US, in state H^{US}, US does not devalue USD. All prices are kept at the normalized level from $t=0$, which is 1. Besides, since prices are sticky, hence $P_H^{US} = 1$.

Similarly, at $t=1$, for China, in state H^{CN}, China does not devalue RMB. All prices are kept at the normalized level from $t=0$, which is 1. Due to the stickiness of prices, $P_H^{CN} = 1$.

Then let us consider an alternative scenario, the state L^{US} for US and L^{CN} for China, in which US and China may devalue their currencies respectively in the disaster state. Suppose each country devalues their currencies, the prices of all firms in respective countries remain sticky in the currencies they use. That is, in US, the price charged by USD-sticky firms is $P_L^{US-USD} = 1$, and the USD price of goods produced by RMB-sticky firms changes to $P_L^{US-RMB} = \frac{1}{e_L^{US}} > 1$; in China, the price charged by RMB-sticky firms is $P_L^{CN-RMB} = 1$, and the RMB price of goods produced by USD-sticky firms changes to $P_L^{CN-USD} = \frac{1}{e_L^{CN}} > 1$.

Therefore, the aggregate USD price of the consumption bundle produced in US after a USD devaluation is

$$\begin{aligned} P_L^{US} &= \left[x\left(P_L^{US-USD}\right)^{1-\sigma^{US}} + (1-x)\left(P_L^{US-RMB}\right)^{1-\sigma^{US}} \right]^{\frac{1}{1-\sigma^{US}}} \\ &= \left[x + (1-x) e_L^{US^{\sigma^{US}-1}} \right]^{\frac{1}{1-\sigma^{US}}} \end{aligned}$$

And the aggregate RMB price of the consumption bundle produced in China after a RMB devaluation is

$$P_L^{CN} = \left[z\left(P_L^{CN-USD}\right)^{1-\sigma^{CN}} + (1-z)\left(P_L^{CN-RMB}\right)^{1-\sigma^{CN}} \right]^{\frac{1}{1-\sigma^{CN}}}$$
$$= \left[z e_L^{CN^{\sigma^{CN}-1}} + (1-z) \right]^{\frac{1}{1-\sigma^{CN}}}$$

The depreciation of USD, *i.e.* $e_L^{US} < 1$, results in a higher aggregate USD price level $P_L^{US} > 1 = P_H^{US}$. Aggregate USD-denominated price inflation P_L^{US} is inversely proportional to the fraction of aggregate prices that are sticky in USD *x*. By intuition, if all prices are sticky in USD ($x = 1$), then the real value of USD is constant despite its nominal depreciation. If all prices are sticky in RMB ($x = 0$), the depreciation of USD in real terms is as much as in nominal terms. In addition, supposing the weight of RMB-sticky firms in US increases, *i.e.* *x* decreases, the pass-through of nominal to real USD depreciation increases.

Likewise, the depreciation of RMB, *i.e.* $e_L^{CN} < 1$, results in a higher aggregate RMB price level $P_L^{CN} > 1 = P_H^{CN}$. Aggregate RMB-denominated price inflation P_L^{CN} is proportional to the fraction of aggregate prices that are sticky in RMB *z*. By intuition, if all prices are sticky in USD ($z = 1$), the depreciation of RMB in real terms is as much as in nominal terms. If all prices are sticky in RMB ($z = 0$), then the real value of RMB is constant despite its nominal depreciation. In addition, supposing the weight of USD-sticky firms in China increases, *i.e.* *z* increases, the pass-through of nominal to real USD depreciation increases.

3. Derivation of Best Response Functions

At date 1 in the respective states L^{US} and L^{CN} respectively, US and CN must decide whether to devalue their currencies or not, which depends on their respective objectives of maximizing each country's real income. The USD is devalued if

$$-b^{US} R^{US} + L^{US-Supply} \leq -\frac{b^{US} R^{US}}{P_L^{US}} + \frac{\pi_L^{US}}{P_L^{US}} - \tau^{US} \tag{7}$$

where the left hand side and the right hand side are respectively US real income without devaluation and with devaluation. If devaluation of USD does not happen, the real value of output is $L^{US-Supply}$ and debt repayment costs $b^{US} R^{US}$, where b^{US} is the USD value of US bonds and R^{US} is the rate on these US bonds. If depreciation of USD happens, real debt repayment $\frac{b^{US} R^{US}}{P_L^{US}}$ is lower than previous level, but the devaluation cost τ^{US} is incurred. The term $\frac{\pi_L^{US}}{P_L^{US}}$ is the real value of output after USD devaluation and it is given by

$$\frac{\pi_L^{US}}{P_L^{US}} = x \frac{P_L^{US-USD}}{P_L^{US}} Y_L^{US-USD} + (1-x) \frac{P_L^{US-RMB}}{P_L^{US}} Y_L^{US-RMB}$$
$$= \frac{\left[x + (1-x) e_L^{US^{\sigma^{US}-1}} \right]^{\frac{\sigma^{US}}{\sigma^{US}-1}}}{x + (1-x) e_L^{US^{\sigma^{US}}}} L^{US-Supply}$$

The RMB is devalued if

$$-b^{CN}R^{CN} + L^{CN-Supply} \le -\frac{b^{CN}R^{CN}}{P_L^{CN}} + \frac{\pi_L^{CN}}{P_L^{CN}} - \tau^{CN} \tag{8}$$

where the left hand side and right hand side are respectively Chinese real income without devaluation and with devaluation. If devaluation of RMB does not happen, the real value of output is $L^{CN-Supply}$ and debt repayment costs $b^{CN}R^{CN}$, where b^{CN} is the RMB value of Chinese bonds and R^{CN} is the rate on these Chinese bonds. If devaluation of RMB happens, real debt repayment $\frac{b^{CN}R^{CN}}{P_L^{CN}}$ is lower than previous level, but the devaluation cost τ^{CN} is incurred. The term $\frac{\pi_L^{CN}}{P_L^{CN}}$ is the real value of output after RMB devaluation and it is given by

$$\begin{aligned}\frac{\pi_L^{CN}}{P_L^{CN}} &= z\frac{P_L^{CN-USD}}{P_L^{CN}}Y_L^{CN-USD} + (1-z)\frac{P_L^{CN-RMB}}{P_L^{CN}}Y_L^{CN-RMB} \\ &= \frac{\left[z+(1-z)e_L^{CN^{\sigma^{CN}-1}}\right]^{\frac{\sigma^{CN}}{\sigma^{CN}-1}}}{z+(1-z)e_L^{CN^{\sigma^{CN}}}}L^{US-Supply}\end{aligned}$$

In this paper, I focus on the effects of price stickiness on US real debt repayment and the Chinese real debt repayment via $\frac{b^{US}R^{US}}{P_L^{US}}$ and $\frac{b^{CN}R^{CN}}{P_L^{CN}}$ respectively. Accordingly, I assume that the changes in real outputs due to the misallocation effects are small for either US or China in comparison. To do these, I take the limit of small L^{US} and L^{CN}.

Even though the static game does not do justice to the dynamic adjustment of prices, the long maturity of debt has compensated this seeming weakness because maturity of the debt is inversely correlated with the time that prices take to adjust.

Following the spirit of Farhi and Maggiori (2018, 2019), my model also feature that the determination of the exchange rate reflects the fact that in bad-enough fiscal situations, monetary policy is de facto dominated by fiscal considerations: for either US or China, their ex-post misbehavior is expected by investors ex-ante, which are completely compensated by the higher bond yields. The devaluation costs make US and China worse off. Neither US nor China commit ex-ante not to misbehave ex-post due to institutional weakness. Therefore, their commitments have to be limited even if full commitments could have made them better off.

According to my proof in the Appendix, for either US or China, the set of best responses, given an amount of Chinese debt b^{CN} or of US debt b^{US}, depends on which of the following three zones the debt falls into: a safety zone, an instability zone, and a collapse zone.

Specifically, given b^{CN}, if $b^{US} \in \left[0, \underline{b}^{US}\right]$, US does not devalue in the disaster state L^{US} at $t=1$, which is called a safe best response; if $b^{US} \in \left(\underline{b}^{US}, \overline{b}^{US}\right]$, there are two types of best responses, the safe best response, and the risky best response, which reflects that the US devalues in L^{US} at $t=1$ given b^{CN}. I assume that in this situation the risky best response is selected with probability α^{US}; if $b^{US} \in \left(\overline{b}^{US}, w^*\right]$, it is the risky best response that the US delivers.

When b^{US} given b^{CN} is in the instability zone, US faces a possible self-fulfilling confidence crisis: given the Chinese debt issuance, if investors expect the US debt safe, the rate on US debt is low, and as a result the US does not devalue USD in case L^{US} happens; if investors expect US debt risky, the rate on US debt is high, and as a result the US devalues USD in case L^{US} happens. The entire best response mechanisms including the confidence crisis described above is fiscal. Following Farhi and Maggiori (2018, 2019), I also call such a confidence crisis by a Triffin event.

Likewise, the best response mechanism of China is also fiscal and given b^{US}, China may also independently face a confidence crisis in L^{CN} at $t=1$. Given b^{US}, if $b^{CN} \in \left[0, b^{CN}\right]$, China does not devalue in the disaster state L^{CN} at $t=1$, which is China's safe best response; if $b^{CN} \in \left(\underline{b}^{CN}, \overline{b}^{CN}\right]$, there are also two types of best responses, the safe best response as just described, and the risky best response, under which China devalues in L^{CN} at $t=1$ given b^{US}. I assume that in this situation the Chinese risky best response is selected with probability α^{CN}.

When b^{CN} given b^{US} is in the instability zone, China faces a possible self-fulfilling confidence crisis: given the US debt issuance, if investors expect Chinese debt safe, the rate on Chinese debt is low, and as a result China does not devalue RMB in case L^{CN} happens; if investors expect Chinese debt risky, the rate on Chinese debt is high, and as a result China devalues RMB in case L^{CN} happens. Therefore, the confidence crisis is fiscal.

Now consider representative agents' debt issuance problems. Given b^{CN}, the US issues debt to maximize the expected utility of US representative agent with respect to the downward-slopping RoW demand curve for the US debt. The resulted rents are the US exorbitant privilege given China's debt issuance. For illustration, I focus on the US best response where α^{US} is high enough so that the US finds it optimal to issue at $\underline{b}^{US}$. Hence, the US faces a new Triffin dilemma reflected by its best responses: given b^{CN}, the US could issue more US debt and get more exorbitant privilege with some probability, while it would also risk losing all of its exorbitant privilege if a confidence crisis happens for US. Therefore, given the parameter specification considered in this paper, the US debt issuance as a best response to China's debt issuance exhibits relative fiscal discipline of US.

Likewise, for China, given b^{US}, China issues debt to maximize the expected utility of Chinese representative agent with respect to the downward-sloping RoW demand curve for the Chinese debt. The resulted rents are the Chinese exorbitant privilege given US debt issuance. For illustration, symmetrically, I focus on the Chinese best response where α^{CN} is high enough so that China finds it optimal to issue at $\underline{b}^{CN}$. However, China faces a new Triffin dilemma reflected by its best responses: given b^{US}, China could issue more Chinese debt and get more exorbitant privilege with some probability, while it could also risk losing all of its exorbitant privilege if a confidence crisis happens for China. Therefore, given the parameter specification considered in this paper, the Chinese debt issuance as the best response to US debt issuance also exhibits relative fiscal discipline of China.

Given all above model specifications and descriptions, by holding the equality of Equations (7) and (8) and reformulating them, the optimality conditions for US and China's debt issuance problems are given by

$$\begin{cases} \underline{b}^{US} \times \dfrac{1}{A^{US}} = \tau^{US} \\ \underline{b}^{CN} \times \dfrac{1}{A^{CN}} = \tau^{CN} \end{cases} \tag{9}$$

where $A^{US} = \dfrac{1-\lambda^{US}}{\bar{R}^{r}\left(1-\dfrac{\lambda^{US}}{P_L^{US}}\right)\left(1-\dfrac{1}{P_L^{US}}\right)}$ and $A^{CN} = \dfrac{1-\lambda^{CN}}{\bar{R}^{r}\left(1-\dfrac{\lambda^{CN}}{P_L^{CN}}\right)\left(1-\dfrac{1}{P_L^{CN}}\right)}$.

Solving the equation group comprised of the two optimality conditions, I obtain the best response functions of US and China respectively:

$$\begin{cases} \underline{b}^{US} = \dfrac{-\left(\underline{b}^{CN} - A^{US}\tau_{US}^{US}\right) + \sqrt{\left(\underline{b}^{CN} - A^{US}\tau_{US}^{US}\right)^2 + 4A^{US}\tau_{US}^{CN}\underline{b}^{CN}}}{2} \\ \underline{b}^{CN} = \dfrac{-\left(\underline{b}^{US} - A^{CN}\tau_{CN}^{CN}\right) + \sqrt{\left(\underline{b}^{US} - A^{CN}\tau_{CN}^{CN}\right)^2 + 4A^{CN}\tau_{CN}^{US}\underline{b}^{US}}}{2} \end{cases} \tag{10}$$

The optimality conditions (9) describe such a situation: the US and China are indifferent between non-devaluing home currencies or devaluing home currencies. However, non-devaluing home currencies are always better than devaluing home currencies. Therefore when US issues an amount of debt by $\underline{b}^{US}$, it does not devalue USD; when China issues an amount of debt by $\underline{b}^{CN}$, it does not devalue RMB. As stated above, α^{US} is high enough so that the optimal debt issuance for US is $\underline{b}^{US}$; α^{CN} is high enough so that the optimal debt issuance for China is $\underline{b}^{CN}$.

The first equality in (9) asks how much debt to issue by US when it stays at the limit status where beyond the amount of issuance, the country has to devalue USD. When it determines the amount of debt issuance, it needs to consider how much debt China issues. Because US knows that value of α^{CN}, therefore the US expects that China will issue $\underline{b}^{CN}$, which will not trigger the devaluation of RMB. At the same time, China is considering a similar problem: how much debt to issue given the amount of debt US issues. China knows that the US will issue $\underline{b}^{US}$ because it knows that value of α^{US}. Therefore, China judges that the US will not devalue USD.

If $-b^{US}R^{US}+L^{US-Supply}>-\frac{b^{US}R^{US}}{P_L^{US}}+\frac{\pi_L^{US}}{P_L^{US}}-\tau^{US}$, then the US does not devalue in bad state at $t=1$. Therefore, the US debt is safe. The interest rate on US debt is then $R^{US}=\bar{R}^r-\gamma\left(w^*-b^{CN}-b^{US}\right)$. I also take the limit of small L^{US} and L^{CN}. Therefore, the above condition is reduced to $\tau^{US}>b^{US}R^{US}\left(1-\frac{1}{P_L^{US}}\right)$.

Likewise, if $-b^{CN}R^{CN}+L^{CN-Supply}>-\frac{b^{CN}R^{CN}}{P_L^{CN}}+\frac{\pi_L^{CN}}{P_L^{CN}}-\tau^{CN}$, then China does not devalue in bad state at $t=1$. Therefore, the Chinese debt is safe. The interest rate on Chinese debt is then $R^{CN}=\bar{R}^r-\gamma\left(w^*-b^{US}-b^{CN}\right)$. Again, I take the limit of small L^{US} and L^{CN}. Therefore, the above condition is reduced to $\tau^{CN}>b^{CN}R^{CN}\left(1-\frac{1}{P_L^{CN}}\right)$.

Given b^{CN}, if $\underline{b}^{US}$ is a safe issuance that does not incur the devaluation of USD, it should satisfy $\tau^{US}>\underline{b}^{US}R^{US}\left(1-\frac{1}{P_L^{US}}\right)$ where $\tau^{US}=\frac{\underline{b}^{US}\tau_{US}^{US}+b^{CN}\tau_{US}^{CN}}{\underline{b}^{US}+b^{CN}}$. Given b^{US}, if $\underline{b}^{CN}$ is a safe issuance that does not incur the devaluation of RMB, it should satisfy $\tau^{CN}>\underline{b}^{CN}R^{CN}\left(1-\frac{1}{P_L^{CN}}\right)$ where $\tau^{CN}=\frac{\underline{b}^{CN}\tau_{CN}^{CN}+b^{US}\tau_{CN}^{US}}{\underline{b}^{CN}+b^{US}}$. In the situation considered above where α^{US} and α^{CN} are large enough, $\underline{b}^{US}$ and $\underline{b}^{CN}$ should simultaneously satisfy

$$\begin{cases}\underline{b}^{US}<B^{US}\tau^{US}\\ \underline{b}^{CN}<B^{CN}\tau^{CN}\end{cases}\tag{11}$$

where $B^{US}=\frac{1}{R^{US}\left(1-\frac{1}{P_L^{US}}\right)}$ and $R^{US}=\bar{R}^r-\gamma\left(w^*-\underline{b}^{CN}-\underline{b}^{US}\right)$;

$\tau^{US}=\frac{\underline{b}^{US}\tau_{US}^{US}+\underline{b}^{CN}\tau_{US}^{CN}}{\underline{b}^{US}+\underline{b}^{CN}}$; $B^{CN}=\frac{1}{R^{CN}\left(1-\frac{1}{P_L^{CN}}\right)}$ and $R^{CN}=\bar{R}^r-\gamma\left(w^*-\underline{b}^{US}-\underline{b}^{CN}\right)$;

$\tau^{CN}=\frac{\underline{b}^{CN}\tau_{CN}^{CN}+\underline{b}^{US}\tau_{CN}^{US}}{\underline{b}^{CN}+\underline{b}^{US}}$. Inequality group (11) implies that if $\underline{b}^{US}$ and $\underline{b}^{CN}$ are safe issuance for US and China respectively, they should satisfy

$$\begin{cases}0<\underline{b}^{US}<\frac{-\left(\underline{b}^{CN}-B^{US}\tau_{US}^{US}\right)+\sqrt{\left(\underline{b}^{CN}-B^{US}\tau_{US}^{US}\right)^2+4B^{US}\tau_{US}^{CN}\underline{b}^{CN}}}{2}\\ 0<\underline{b}^{CN}<\frac{-\left(\underline{b}^{US}-B^{CN}\tau_{CN}^{CN}\right)+\sqrt{\left(\underline{b}^{US}-B^{CN}\tau_{CN}^{CN}\right)^2+4B^{CN}\tau_{CN}^{US}\underline{b}^{US}}}{2}\end{cases}\tag{12}$$

At present, the capital account of China is not opened and capital control of China is tight. Besides, the US has passed legislation to tighten US investment to

China, especially investment in high tech areas (White House, 2023). Because the frictions between US and China become more and more fierce, it is reasonable to expect that measures that control US capital flow to China will be expanded. Such measures also control the flow of American capital to China which affects the exchange rates of USD over RMB. Therefore, even though this paper studies the situation of a rivalry between USD and RMB in future, no one can guarantee that by then there would be no capital control between US and China. Therefore, the violation of no arbitrage condition, *i.e.* $e^{US}e^{CN} \neq 1$ where $e^{US} \in \mathbb{R}^+$ and $e^{CN} \in \mathbb{R}^+$, is possible. My model just considers the situation where the no arbitrage condition is not held between US and China.

4. The Strategic Impact of Opponent Country's Net Issuance of Safe Assets on a Country's Own Safe Asset Issuance

The best response functions can support the analysis of the impact of the opponent's net issuance of safe assets on a country's own safe asset issuance. One country's issuance of safe assets is a measure of the country's economic weight globally.

First, think about a situation where US encounters the increasing net supply of safe Chinese bonds $\underline{b}^{CN}$. The reaction of US depends on the comparison between τ_{US}^{CN} and τ_{US}^{US}, and the change of the US exorbitant privilege also depends on the comparison between τ_{US}^{CN} and τ_{US}^{US}. In fact, if $\tau_{US}^{CN} > \tau_{US}^{US}$, $\frac{\partial \underline{b}^{US}}{\partial \underline{b}^{CN}} > 0$ and if $\tau_{US}^{CN} < \tau_{US}^{US}$, $\frac{\partial \underline{b}^{US}}{\partial \underline{b}^{CN}} < 0$. Therefore, if the devaluation cost the US pays to China, *i.e.* the benefits US loses to China in international monetary system and international price system, is greater than the devaluation cost the US pays towards itself, *i.e.* the blow to US domestic economy due to experiencing the Triffin event, US exhibits strategic complements towards Chinese debt issuance and the rising net issuance of Chinese debt makes US less sensitive to devaluation; if the devaluation cost the US pays towards China is less than the devaluation cost the US pays towards itself, US exhibits strategic substitutes towards Chinese debt issuance and the rising net issuance of Chinese debt makes US more sensitive to devaluation.

Second, think about a situation where China encounters the decreasing net supply of US safe bonds $\underline{b}^{US}$. The reaction of China depends on the comparison between τ_{CN}^{US} and τ_{CN}^{CN}, and the change of Chinese exorbitant privilege also depends on the comparison between τ_{CN}^{US} and τ_{CN}^{CN}. In fact, if $\tau_{CN}^{US} > \tau_{CN}^{CN}$, $\frac{\partial \underline{b}^{CN}}{\partial \underline{b}^{US}} > 0$ and if $\tau_{CN}^{US} < \tau_{CN}^{CN}$, $\frac{\partial \underline{b}^{CN}}{\partial \underline{b}^{US}} < 0$. Therefore, if the devaluation cost China pays to US, *i.e.* the benefits China loses to US in international monetary system and international price system, is greater than the devaluation cost China pays towards itself, *i.e.* the gigantic amount of resources devoted to saving the severely suffered Chinese economy, China exhibits strategic complements towards US debt and the decreasing net supply of US debt also makes China more sensitive to devaluation; if the devaluation cost China pays to US is less than the devaluation cost China pays towards itself, China exhibits strategic substitutes towards US debt and the decreasing net supply of US debt makes China less sensitive to devaluation.

The exorbitant privilege will always decrease due to the rising issuance of opponent country's safe assets, no matter whether a country exhibits strategic complements or strategic substitutes. As China issues a rising amount of safe assets worldwide, such a trend reduces the US exorbitant privilege, even though the US exhibits strategic complements given the cost structure $\tau_{US}^{CN} > \tau_{US}^{US}$. Likewise, as US issues a rising amount of safe assets worldwide, such a trend reduces the Chinese exorbitant privilege, given that China exhibits strategic substitutes for a cost structure $\tau_{CN}^{CN} > \tau_{CN}^{US}$. The residual demand for US safe assets as in equation 1) is decreasing in the amount of Chinese safe assets. The residual demand for Chinese safe assets as in equation 2) is decreasing in the amount of US safe assets. For US, the total loss of revenue $\underline{b}^{US}\gamma b^{CN}$ is proportional to the size of Chinese issuance. For China, the total loss of revenue $\underline{b}^{CN}\gamma b^{US}$ is proportional to the size of US issuance.

Therefore, in my model, US and China may not simply both exhibit strategic substitutes or strategic complements like typical game theoretical models. There exists a possible scenario that one country exhibits strategic complements while the other country exhibits strategic substitutes, which is determined by the cost specifications. Correspondingly, the revealed behavior of countries, *i.e.* strategic complements or strategic substitutes, also expresses the relationship between different devaluation costs. Based on observations of the diplomatic relationship of US and China from the Western perspective, US is more prone to be a strategic-complements player, which repeatedly emphasizes the importance of cooperation between the two countries as shown in the US Presidential addresses etc., while China is more prone to be a strategic-substitutes player, which is very assertive to challenge the US comprehensively, e.g. challenging the USD's status in international monetary system and international price system. Therefore, according to my model, such behaviors in political reality from the Western perspective show that $\tau_{US}^{US} < \tau_{US}^{CN}$ for US and $\tau_{CN}^{CN} > \tau_{CN}^{US}$ for China.

If China fails in any challenge it initiated towards US, then the corresponding efforts that China has invested to internationalize RMB in the international monetary system and international price system would be wasted. If such event repeatedly happens, then all fruits China has accumulated for internationalizing RMB would be given to the US (τ_{CN}^{US}). Hence, τ_{CN}^{US} can be regarded as the discounted value of all future costs China pays to US for any failure towards US. However, more importantly, the failure of China towards US will ultimately lead to the severe suffering of the Chinese economy. If China wanted to save its economy, the Chinese government would invest a gigantic amount of resources to do it (τ_{CN}^{CN}), which is much greater than the benefits that China gives up to US due to the failure of the currency war. Therefore, the devaluation costs according to the above analysis also exhibit the relationship that $\tau_{US}^{US} < \tau_{US}^{CN}$ for US and $\tau_{CN}^{CN} > \tau_{CN}^{US}$ for China.

5. Equilibrium

As just discussed, the devaluation costs of US and China exhibit features such that $\tau_{US}^{US} < \tau_{US}^{CN}$ and $\tau_{CN}^{CN} > \tau_{CN}^{US}$. For the purpose of illustration, I further assume that $\tau_{US}^{US}\tau_{CN}^{CN} = \tau_{US}^{CN}\tau_{CN}^{US}$, which presents a more concrete relationship among the devaluation costs. Devaluation costs are changing across time in reality and the relationship about the devaluation costs described in the assumption is reasonable to appear in certain periods. Consider the aggregate cost

$$\tau^{US} = \frac{\underline{b}^{US}\tau_{US}^{US} + \underline{b}^{CN}\tau_{US}^{CN}}{\underline{b}^{US} + \underline{b}^{CN}} = \frac{\underline{b}^{US}\tau_{CN}^{US} + \underline{b}^{CN}\tau_{CN}^{CN}}{\underline{b}^{US} + \underline{b}^{CN}} \times \frac{\tau_{US}^{CN}}{\tau_{CN}^{CN}}$$

and

$$\tau^{CN} = \frac{\underline{b}^{US}\tau_{CN}^{US} + \underline{b}^{CN}\tau_{CN}^{CN}}{\underline{b}^{US} + \underline{b}^{CN}}$$

As I have described, the cost τ_{US}^{CN} represents the benefits that the US loses and China gains due to the devaluation of USD, and the cost τ_{CN}^{CN} represents the gigantic cost China pays to save its economy due to the devaluation of RMB. In this paper, I consider a scenario that the aggregate devaluation costs of the two nations are similar, *i.e.* $\tau^{US} \approx \tau^{CN}$. Therefore according to the above formulas, $\tau_{US}^{CN} \approx \tau_{CN}^{CN}$.

In fact, it can be assumed that $\tau_{US}^{CN} \approx \tau_{CN}^{CN}$. The opinion that $\tau_{US}^{CN} \approx \tau_{CN}^{CN}$ is based on the following reasons: observing the history of USD since 1945, the status and power of the currency generally decline. The political status related with the decline of USD also falls down as a result, making the power of US, even though still a hegemon in the world, gradually fade. From the Western perspective, in the following decades, if US continues losing its current benefits in IMS in the challenge from China, which finally leads to the collapse/change of the present international monetary system and international price system, the country benefited most from this event will be China, which will consolidate China's economy and help China gain the benefits in the international monetary system and international price system which US once enjoyed. A new international monetary system as well as a new international price system, and even a new world order centered by China is therefore established.

Otherwise, if China loses the currency war with US, it will severely suffer Chinese economy. The US is certainly the direct beneficiary of the suffering of the Chinese economy in the rivalry situation. At least, due to the event, the US will gain the political and financial benefits that China used to enjoy, which can help the US restore its power in international monetary system and international price system the country once held.

Therefore, the devaluation cost China pays to the US and the devaluation cost China pays to itself are hefty and more or less similar, *i.e.* $\tau_{CN}^{US} \approx \tau_{CN}^{CN}$.

Given the best response functions and the assumption that $\tau_{US}^{US}\tau_{CN}^{CN} = \tau_{US}^{CN}\tau_{CN}^{US}$, I obtain the equilibrium issuance of US and China respectively:

$$\begin{cases} \underline{b}^{US} = A^{US} \times \tau_{A}^{US} \\ \underline{b}^{CN} = A^{CN} \times \tau_{A}^{CN} \end{cases} \tag{13}$$

where $\tau_{A}^{US} = \dfrac{A^{CN}\left(\tau_{CN}^{CN} - \tau_{CN}^{US}\right)\tau_{US}^{CN} + A^{US}\left(\tau_{US}^{CN} - \tau_{US}^{US}\right)\tau_{US}^{US}}{A^{CN}\left(\tau_{CN}^{CN} - \tau_{CN}^{US}\right) + A^{US}\left(\tau_{US}^{CN} - \tau_{US}^{US}\right)}$ and

$\tau_{A}^{CN} = \dfrac{A^{CN}\left(\tau_{CN}^{CN} - \tau_{CN}^{US}\right)\tau_{CN}^{CN} + A^{US}\left(\tau_{US}^{CN} - \tau_{US}^{US}\right)\tau_{CN}^{US}}{A^{CN}\left(\tau_{CN}^{CN} - \tau_{CN}^{US}\right) + A^{US}\left(\tau_{US}^{CN} - \tau_{US}^{US}\right)}$. The equilibrium expressed by equation group (13) is assumed to satisfy condition (12) by default.

6. The Explanation of the Asymmetry between the US Safe Asset Issuance and Chinese Safe Asset Issuance

In terms of the volume of the issued safe assets, the Chinese issuance is far more behind the US issuance. According to my model, it means $\underline{b}^{US} > \underline{b}^{CN}$. Although the equilibrium safe asset issuance in my model is obtained under the prerequisite that α^{US} and α^{CN} are high enough, and under the assumption $\tau_{US}^{US}\tau_{CN}^{CN} = \tau_{US}^{CN}\tau_{CN}^{US}$ which describes a situation about the relationship of the devaluation costs between US and China, the status that the volume of US safe asset issuance and the Chinese safe asset issuance are asymmetric is expected not to be changed.

My model abstracts away the impact of various factors such as national strength on the volume of safe asset issuance in equilibrium. National strength is a particular factor that people usually focus on when discussing international currency issues. Therefore, in the case considered in the paper, why the asymmetric issuance between US and China happens? Even though the equilibrium in my model is derived under specific prerequisite and assumption, my model can provide an answer to account for such asymmetry, which can arise from factors rather than national strength. Note that the prerequisite and assumption can also describe reality though they cannot cover general situations.

According to Equation (13), $\underline{b}^{US} > \underline{b}^{CN}$ can be reformulated to

$$\frac{\tau_{US}^{US}}{\tau_{CN}^{US}} > \frac{\dfrac{\lambda^{US}}{1-\lambda^{US}}\left[\dfrac{1}{P_L^{US2}} - \left(\dfrac{1}{\lambda^{US}}+1\right)\dfrac{1}{P_L^{US}} + \dfrac{1}{\lambda^{US}}\right]}{\dfrac{\lambda^{CN}}{1-\lambda CN}\left[\dfrac{1}{P_L^{CN2}} - \left(\dfrac{1}{\lambda^{CN}}+1\right)\dfrac{1}{P_L^{CN}} + \dfrac{1}{\lambda^{CN}}\right]}$$

Therefore, in the context considered in my model, beyond national strength, the devaluation cost of US towards itself τ_{US}^{US}, the devaluation cost of China towards US τ_{CN}^{US}, the probability that the disaster state happens for US λ^{US}, the probability that the disaster state happens for China λ^{CN}, the aggregate USD price level in disaster state P_L^{US} and the aggregate RMB price level in disaster state P_L^{CN} can also result in an asymmetric issuance between US and China. Obviously, the greater contrast between $\frac{\tau_{US}^{US}}{\tau_{CN}^{US}}$ and $\frac{\frac{\lambda^{US}}{1-\lambda^{US}}\left[\frac{1}{P_L^{US2}}-\left(\frac{1}{\lambda^{US}}+1\right)\frac{1}{P_L^{US}}+\frac{1}{\lambda^{US}}\right]}{\frac{\lambda^{CN}}{1-\lambda^{CN}}\left[\frac{1}{P_L^{CN2}}-\left(\frac{1}{\lambda^{CN}}+1\right)\frac{1}{P_L^{CN}}+\frac{1}{\lambda^{CN}}\right]}$ are, the greater contrast between $\underline{b}^{US}$ and $\underline{b}^{CN}$ and hence the asymmetry is greater. Considering that at present the Chinese safe asset issuance is significantly dwarfed by the US issuance, therefore it is meaningful to study how these factors can make the contrasts as mentioned greater.

First, let us consider the impact of devaluation costs. Either the greater value of the devaluation cost of US towards itself or the smaller value of the devaluation cost of China towards US can make the asymmetry greater. Intuitively, the greater the devaluation cost of US towards itself is, the more self-disciplined of US is on the matter of issuing safe asset and hence the greater their safety zone is. Hence, the US can issue safer asset in this situation. While for China, the smaller the devaluation cost of China towards US, the bolder China is on issuing safe assets. Hence, China becomes less self-disciplined on this issue and hence the Chinese safety zone becomes smaller, which reduces the volume of safe asset that China can issue. Note that the devaluation cost of US towards China and the devaluation cost of China towards itself do not matter in making the asymmetry happen. Such feature shows that in the strategic interaction between US and China on issuing safe assets, China is less important than US in determining the contrast between the volume of US issuance and the volume of Chinese issuance.

Second, consider the probability that the disaster state happens for US λ^{US} and the probability that the disaster state happens for China λ^{CN}. The smaller probability that the disaster state happens for US or the greater probability that the disaster state happens for China can make the asymmetry between the safe asset issuance of US and China greater. Intuitively, the smaller probability that the disaster state happens for US, the less chance that US has to consider whether to devalue USD and hence US can issue more safe asset; however, the greater probability that the disaster state happens for China, the more chance that US has to consider whether to devalue RMB and hence China has to be self-restraint on issuing safe asset. Due to the dominant status of US in world economy, once US economy enters a disaster state, which usually contagions the whole world including Chinese economy. Therefore, the probability that China encounters a disaster state is hard to be less than the probability that US encounters a disaster state.

Third, consider the aggregate USD price level in disaster state P_L^{US} and the aggregate RMB price level in disaster state P_L^{CN}. The smaller aggregate USD price level in disaster state or the greater aggregate RMB price level in disaster state can make the asymmetry between the safe asset issuance of US and China greater. Intuitively, if disaster state happens, the cheaper (more expensive) the consumption bundle of a country denominated by its home currency is, the more (less) the country can gain from international trade, which boosts (reduces) the country's fiscal capacity. Therefore, the country's safety zone is greater (smaller) and hence can issue more (less) safe asset. The aggregate price level of US and China are constantly changing. At present, due to high US inflation, P_L^{US} is expected to increase; due to the looming Chinese deflation, P_L^{CN} is expected to decrease. Therefore, at present, the aggregate price levels of US and China are counter forces that make the asymmetry of safe asset issuance of US and China greater. However, because the volume of US safe asset issuance is much more larger than the volume of Chinese safe asset issuance at present, therefore from my model it can be found that the impact of the devaluation costs and the impact of the probability that disaster state happens dominate the impact of aggregate price levels (the assumption $\tau_{US}^{US}\tau_{CN}^{CN} = \tau_{CN}^{US}\tau_{US}^{CN}$ is reasonably to hold at least for certain period at present). Therefore, to analyze safe asset issuance of US and China at present, the devaluation costs of US and China towards US and the probability that disaster state happens for US and China are the critical factors that needs delving into.

7. The Impact of the Share of Pricing and Invoicing of One Currency on Both Countries' Debt Issuance

In the following, I focus on the impact of the share of pricing and invoicing of one currency on both countries' debt issuance. First, let me start from the US equilibrium issuance $\underline{b}^{US}$. Suppose RMB's weight in US economy increases ($1-x$ increases), *i.e.* the fraction of goods denominated in RMB produced in US are rising and the fraction of good denominated in USD produced in US are falling. Such a change in the currency denomination leads to $\frac{\partial \underline{b}^{US}}{\partial x} > 0$, and $\frac{\partial \underline{b}^{CN}}{\partial x} < 0$ which is particularly obtained given the assumption that $\tau_{US}^{CN} > \tau_{US}^{US}$ and $\tau_{CN}^{CN} > \tau_{CN}^{US}$. Therefore, the increase of RMB's weight in US economy leads to a strengthened sensitivity of USD devaluation in US and a reduced sensitivity of RMB devaluation in China. Or, it can be said that the increase of RMB's weight in US economy makes the original level of US debt $\underline{b}^{US}$ no longer in the safety zone but instead in the instability zone, while the original level of Chinese debt $\underline{b}^{CN}$ becomes safer as the safety zone enlarges and therefore alleviates China's fiscal burden.

To understand these effects, let me go back to the expressions of the equilibrium debt issuance $\underline{b}^{US}$ and $\underline{b}^{CN}$. $\underline{b}^{US} = A^{US} \times \tau_A^{US}$. τ_A^{US} represents the impact of devaluation costs on the devaluation threshold. It is a weighted average of the devaluation costs τ_{US}^{CN} and τ_{US}^{US} with the weights $\frac{A^{CN}\left(\tau_{CN}^{CN}-\tau_{CN}^{US}\right)}{A^{CN}\left(\tau_{CN}^{CN}-\tau_{CN}^{US}\right)+A^{US}\left(\tau_{US}^{CN}-\tau_{US}^{US}\right)}$.

Note that τ_{US}^{CN} and τ_{US}^{US} also have impact on the weights. A^{US} represents the impact of ex-post benefit of USD devaluation. Specifically, the interpretation of A^{US} is as follows:

$$A^{US} = \frac{1}{1-\frac{1}{P_L^{US}}} \times \frac{1-\lambda^{US}}{\bar{R}^r\left(1-\frac{\lambda^{US}}{P_L^{US}}\right)} \tag{14}$$

The first term of A^{US} shows that a lower x leads to a higher P_L^{US}, which makes a USD devaluation reduce more US real debt repayment. It then makes the ex-post benefit of a USD devaluation higher, which makes the safety zone smaller. The second term compounds the impact of the first term: a lower x leads to a higher P_L^{US}, which makes the US debt riskier and its yield higher. Such an impact makes the safety zone smaller. In addition, the higher $\bar{R}^r$ makes the fiscal burden of US higher, which provides a stronger incentive of devaluing USD and hence ultimately reduces the safety zone. Therefore, in terms of the ex-post devaluation benefit of USD, the rise of RMB in pricing and invoicing in US increases the ex-post devaluation benefit of USD.

However, the movement of τ_A^{US} is opposite to that of A^{US} with an increasing share of RMB in pricing and invoicing in US. The RMB share's impact on τ_A^{US}, the impact of devaluation costs on $\underline{b}^{US}$, is performed through A^{US}, the impact of ex-post benefit of USD devaluation. A lower A^{US} due to a lower x brings a higher τ_A^{US}. The higher average devaluation cost finally leads to a higher $\underline{b}^{US}$, which rewards the higher average devaluation costs.

The ultimate impact of rising pricing and invoicing using RMB in US shows that the impact of ex-post devaluation benefit on $\underline{b}^{US}$ dominates the impact of devaluation costs on $\underline{b}^{US}$, which is reflected by $\frac{\partial \underline{b}^{US}}{\partial x} > 0$. The impact of ex-post devaluation benefits on $\underline{b}^{US}$ magnifies the fiscal pressures on US monetary policy and increases the likelihood of devaluation, while the impact of devaluation costs on $\underline{b}^{US}$ reduces the fiscal pressures on US monetary policy and the likelihood of devaluation. The net impact $\frac{\partial \underline{b}^{US}}{\partial x} > 0$ indicates that the rising share of pricing and invoicing in RMB in US ultimately intensify the pass-through of nominal to real USD devaluation. Therefore, investors expect the devaluation and consequently the safety zone is reduced. In this situation, the new Triffin dilemma occurs for US: it must either issue less debt or undergo a confidence crisis. The exorbitant privilege of US is accordingly reduced.

$\underline{b}^{CN} = A^{CN} \times \tau_A^{CN}$. τ_A^{CN} represents the impact of devaluation costs on the devaluation threshold. It is a weighted average of the devaluation costs τ_{CN}^{CN} and τ_{CN}^{US} with the weights $\frac{A^{CN}\left(\tau_{CN}^{CN}-\tau_{CN}^{US}\right)}{A^{CN}\left(\tau_{CN}^{CN}-\tau_{CN}^{US}\right)+A^{US}\left(\tau_{US}^{CN}-\tau_{US}^{US}\right)}$ and

$\frac{A^{US}\left(\tau_{US}^{CN}-\tau_{US}^{US}\right)}{A^{CN}\left(\tau_{CN}^{CN}-\tau_{CN}^{US}\right)+A^{US}\left(\tau_{US}^{CN}-\tau_{US}^{US}\right)}$. Note that τ_{CN}^{CN} and τ_{CN}^{US} also have impact on the weights. The impact on $\underline{b}^{CN}$ of RMB share in US is performed through A^{US}, the impact of ex-post benefit of USD devaluation. A lower A^{US} due to a lower x brings a higher τ_{A}^{CN}. The RMB share in US does not have any impact on the ex-post benefit of RMB devaluation. Therefore, only the average devaluation cost τ_{A}^{CN} matters in this scenario.

The higher average devaluation cost finally leads to a higher $\underline{b}^{CN}$, which rewards the higher devaluation cost. Therefore, due to the increasing share in pricing and invoicing by RMB in US, the safety zone of China is enlarged.

Next, let me discuss the impact of USD share in pricing and invoicing in China on $\underline{b}^{CN}$ and $\underline{b}^{US}$ respectively. Suppose USD's weight in Chinese economy increases (z increases), *i.e.* the fraction of goods denominated in USD produced in China are rising and the fraction of goods denominated in RMB produced in China are falling. Such a change in the currency denomination leads to $\frac{\partial \underline{b}^{CN}}{\partial z}<0$, and $\frac{\partial \underline{b}^{US}}{\partial z}<0$ which is particularly obtained given the assumption that $\tau_{US}^{CN}>\tau_{US}^{US}$ and $\tau_{CN}^{CN}>\tau_{CN}^{US}$. Therefore, the increase of USD's weight in Chinese economy leads to a strengthened sensitivity of RMB devaluation in China as well as a strengthened sensitivity of USD devaluation in US. Alternatively, it can be said that the increase of USD's weight in Chinese economy makes the original level of Chinese debt $\underline{b}^{CN}$ and US debt $\underline{b}^{US}$ no longer in their safety zones respectively but instead in their respective instability zones.

As presented, $\underline{b}^{CN}=A^{CN}\times\tau_{A}^{CN}$. The meaning of τ_{A}^{CN} has been discussed above. A^{CN} represents the impact on $\underline{b}^{CN}$ by ex-post benefit of RMB devaluation. Specifically, the interpretation of A^{CN} is as follows:

$$A^{CN}=\frac{1}{1-\frac{1}{P_{L}^{CN}}}\times\frac{1-\lambda^{CN}}{\bar{R}^{r}\left(1-\frac{\lambda^{CN}}{P_{L}^{CN}}\right)} \tag{15}$$

The first term of A^{CN} shows that a higher z leads to a higher P_{L}^{CN}, which makes a RMB devaluation reduce more Chinese real debt repayment. It then makes the ex-post benefit of a RMB devaluation higher, which makes the safety zone smaller. The second term compounds the impact of the first term: a higher z leads to a higher P_{L}^{CN}, which makes the Chinese debt riskier and its yield higher. Such an impact makes the safety zone smaller. In addition, the higher $\bar{R}^{r}$ makes the fiscal burden of China higher, which provides a stronger incentive to devalue RMB and hence ultimately reduces the safety zone. Therefore, in terms of the ex-post devaluation benefit of RMB, the rise of USD in pricing and invoicing in China increases the ex-post devaluation benefit of RMB.

Contrary to the phenomenon in US, the movement of τ_{A}^{CN} is in the same direction of A^{CN} with an increasing share of USD in pricing and invoicing in China. The USD share's impact on τ_A^{CN} is performed through A^{CN}, the impact of ex-post benefit of RMB devaluation. A lower A^{CN} due to a higher z brings a lower τ_A^{CN}. The lower average devaluation cost finally leads to a lower $\underline{b}^{CN}$, which increases the likelihood that China experiences a confidence crisis.

The ultimate impact of rising pricing and invoicing using USD in China shows that the impact of ex-post devaluation benefits on $\underline{b}^{CN}$ compounds the impact of devaluation costs on $\underline{b}^{CN}$, which is reflected by $\frac{\partial b^{CN}}{\partial z} < 0$. The impact of ex-post devaluation benefits on $\underline{b}^{CN}$ magnifies the fiscal pressures on Chinese monetary policy and increases the likelihood of devaluation. The aggregate impact $\frac{\partial \underline{b}^{CN}}{\partial z} < 0$ indicates that the rising share of pricing and invoicing in RMB in China ultimately reduces the pass-through of nominal to real RMB devaluation. Therefore, investors expect the devaluation and consequently the safety zone is enlarged. In this situation, the new Triffin dilemma becomes less likely to occur for China: China can increase debt issuance and less likely experience a confidence crisis. The exorbitant privilege of China is accordingly increased.

The impact on $\underline{b}^{US}$ of RMB share $1-z$ in China is performed via A^{CN}, the impact of ex-post benefit of RMB devaluation. A higher A^{CN} due to a lower z brings a higher τ_A^{US}. The intuition is straightforward: the more RMB is used, the further the impact of ex-post devaluation on $\underline{b}^{CN}$ is weakened, which further reduces the fiscal pressures on Chinese monetary policy and decreases the likelihood of devaluation. The RMB share in China does not have any impact on the ex-post benefit of USD devaluation. Therefore, only the average devaluation cost τ_A^{US} matters in this scenario.

The higher average devaluation cost finally leads to a higher $\underline{b}^{US}$, which reduces the risk of USD devaluation. Therefore, due to the increasing share in pricing and invoicing by RMB in China, the safety zone of US is enlarged.

8. The Impact of the Expected Degree of Devaluation of Both Countries' Currencies on Their Devaluation Thresholds

Except the share of domestic production traded in a specific currency in one country, the exchange rates can also exert their impacts on both countries' devaluation thresholds. The expected degree of devaluing a currency in a disaster state matters when predicting how the devaluation threshold changes. Consistent with expectation, the greater expected degree of a devaluation of USD makes US more sensitive to Triffin event ($\frac{\partial \underline{b}^{US}}{\partial e_L^{US}} > 0$) and the greater expected degree of a devaluation of RMB makes China more sensitive to Triffin event ($\frac{\partial \underline{b}^{CN}}{\partial e_L^{CN}} > 0$).

In the game, the expected degree of a devaluation of a country's currency also plays a strategic role that affects the opponent country's likelihood of experiencing the Triffin event. I find that the greater expected degree of a devaluation of USD enlarges China's safety zone ($\frac{\partial b^{CN}}{\partial e_L^{US}} < 0$) while the greater expected degree of a devaluation of RMB reduces US safety zone ($\frac{\partial b^{US}}{\partial e_L^{CN}} > 0$). Such strategic impacts are performed through the impact of ex-post benefits of devaluation A^{US} and A^{CN} respectively but originate from the cost relationship $\tau_{US}^{US} < \tau_{US}^{CN}$ and $\tau_{CN}^{CN} > \tau_{CN}^{US}$, which determines that US is willing to cooperate with China while China wants to compete with US. Thus, when the expected degree of a devaluation of USD becomes greater, investors acknowledge that devaluing USD by US is a more cooperative move of US towards China, which reduces China's fiscal pressure. Consequently, the Chinese safety zone is enlarged. When the expected degree of a devaluation of RMB becomes greater, investors regard devaluing RMB by China as a more assertive move of China towards US, which increases US fiscal pressure. Consequently, the US safety zone is reduced. Therefore, a greater expected degree of USD devaluation benefits China but a greater expected degree of RMB devaluation hurts US.

9. Conclusion

According to the analysis in this paper, a general principle can be found that any actions that are taken by US and hurt (benefit) US benefit (hurt) China, while any actions that are taken by China and hurt (benefit) China hurt (benefit) US. Here one country benefited means the country becomes less likely to experience a Triffin event due to either its own action or its opponent's action, while one country harmed means the country becomes more likely to experience a Triffin event due to either its own action or its opponent's action. Such a principle is founded on the devaluation cost structures of both countries: $\tau_{US}^{US} < \tau_{US}^{CN}$ and $\tau_{CN}^{US} < \tau_{CN}^{CN}$. Therefore, the US tends to cooperate with China, while China wants to compete with the US in the international monetary system and international price system. The situation is consistent with the main stream Western view on Sino-US relationship including the currency issues. As reflected by the model, if China wants to outpace the US in safe asset issuance, then the actions China takes is not beneficial towards itself. Therefore, given the Western view on Sino-US relationship, it is impossible for China to possess an ambition to replace the US as the dominant power of the international monetary system and international price system.

As the cost structures seem hard to change (US more emphasizes its role in the international monetary system and international price system while China more cares its domestic affairs including its economy), the strategic complements of the US issuance behavior and the strategic substitutes of China's issuance behavior are expected hardly to change as well. Therefore, how a cooperative US copes with an assertive China is an important question to answer. However, it is difficult to answer the question according to my model. It seems that the only way to change the situation is just changing the structure of the devaluation costs, which is expected to be in the scope of politics rather than economics.

Again, I emphasize that the results obtained in this paper are based on the Western perspective on Sino-US relationship in particular on currency issues. The model can also account for an equilibrium of such a currency rivalry from the Chinese perspective, but the parameter specification in the model needs adjustment according to the Chinese perspective. Therefore, in expectation, the results obtained from the Chinese perspective will be different from the results obtained in this paper, given the fact that the views on Sino-US relationship from the Chinese side are usually opposite to their counterparts from the Western side. From a practical point of view, for policy makers in both countries who aim to find a way to deal with the strategic interaction as studied in this paper, the prerequisite condition for them to do so is to narrow the gap in their views about Sino-US relationship including the currency issues.

Conflicts of Interest

The author reports there are no competing interests to declare.

References

Caballero, R. J., Farhi, E., & Gourinchas, P. (2017). The Safe Assets Shortage Conundrum. *Journal of Economic Perspectives, 31,* 29-46. https://doi.org/10.1257/jep.31.3.29

Farhi, E., & Maggiori, M. (2018). A Model of the International Monetary System. *The Quarterly Journal of Economics, 133,* 295-355. https://doi.org/10.1093/qje/qjx031

Farhi, E., & Maggiori, M. (2019). China versus the United States: IMS Meets IPS. *AEA Papers and Proceedings, 109,* 476-481. https://doi.org/10.1257/pandp.20191057

Gete, P., & Melkadze, G. (2020). A Quantitative Model of International Lending of Last Resort. *Journal of International Economics, 123,* Article ID: 103290. https://doi.org/10.1016/j.jinteco.2020.103290

Hoffmann, E. J., & Sabarwal, T. (2019). Global Games with Strategic Complements and Substitutes. *Games and Economic Behavior, 118,* 72-93. https://doi.org/10.1016/j.geb.2019.08.007

Karp, L., Lee, I. H., & Mason, R. (2007). A Global Game with Strategic Substitutes and Complements. *Games and Economic Behavior, 60,* 155-175. https://doi.org/10.1016/j.geb.2006.10.003

Tass News Agency (2023). *Yuan to Replace Dollar as Global Reserve Currency in Coming Decade—VTB CEO.* https://www.tass.com/economy/1621833

White House (2023). *Executive Order on Addressing United States Investments in Certain National Security Technologies and Products in Countries of Concern.*

Appendix A. Setup of the Decision Problems of RoW, US and China

Consistent with Farhi and Maggiori (2018, 2019), my model also follows the Calvo timing. Therefore, the timeline of my model is:

$t = 0^-$: US chooses b^{US} and China chooses b^{CN};

$t = 0^+$: RoW chooses R^{US} and R^{CN} respectively. Sunspots for US and China are realized respectively, and hence equilibrium selection happens for both countries;

$t = 1$: 1) Disaster shocks are realized for US and China respectively; 2) US chooses e^{US} and China chooses e^{CN}; 3) Payoffs are obtained for RoW, US and China.

In the following proofs in this section, the meaning of notations $\mathbb{E}^+[x]$, $\mathbb{E}^s[x]$, $\mathbb{E}^r[x]$ and $\mathbb{E}^-[x]$ follow the Definition 1 in Farhi and Maggiori (2018): $\mathbb{E}^+[x]$ represents the expectation taken at $t = 0^+$; $\mathbb{E}^s[x]$ represents the expectation taken at $t = 0^+$ conditional on the safe realization of the sunspot; $\mathbb{E}^r[x]$ represents the expectation taken at $t = 0^+$ conditional on the risky realization of the sunspot; $\mathbb{E}^-[x]$ represents the expectation taken at $t = 0^-$ before the sunspot realization.

A1. RoW's Decision Problem

RoW does not consume at $t = 0$. It has a mean variance preference over consumption at $t = 1$. RoW's problem can be formulated to:

$$\max_{b^{US}, b^{CN}, C_1^*} \mathbb{E}^+\left[C_1^*\right] - \gamma Var^+\left[C_1^*\right]$$

s.t.

$$w^* = x^* + b^{US} + b^{CN}$$

$$x^* R^r + b^{US} R^{US} e_L^{US} + b^{CN} R^{CN} e_L^{CN} = C_1^*$$

$$x^* \geq 0 \quad b^{US} \geq 0 \quad b^{CN} \geq 0$$

In the above decision problem, if no arbitrage condition is required, $e_L^{US} > 1$ or e_L^{CN} can be allowed. By solving the problem, the demand functions of b^{US} and b^{CN} are given by

$$R^{US}\left(b^{US}\right) = \bar{R}^r - 2\gamma\sigma^2\left(w^* - b^{CN} - b^{US}\right)$$

$$R^{CN}\left(b^{CN}\right) = \bar{R}^r - 2\gamma\sigma^2\left(w^* - b^{US} - b^{CN}\right)$$

where σ^2 is the variance of the risky asset issued in US market and the variance of the risky asset issued in Chinese market. For simplicity, I assume the variances of both risky assets are identical. In addition, with generality, assume $\sigma^2 = \frac{1}{2}$. Therefore, I obtain the ultimate form of the safe asset demand function as presented in the main text of the paper:

$$R^{US}\left(b^{US}\right)=\bar{R}^{r}-\gamma\left(w^{*}-b^{CN}-b^{US}\right)$$

$$R^{CN}\left(b^{CN}\right)=\bar{R}^{r}-\gamma\left(w^{*}-b^{US}-b^{CN}\right)$$

A2. The Issuance Problems for US and China

According to the timeline, the issuance happens at $t=0^{-}$. Issuance by US is described by the following problem:

$$\max_{x^{US},b^{US},C_0^{US},C_1^{US}\left(\omega^{US}\right)}\mathbb{E}^{-}\left\{C_0^{US}+\delta^{US}\left[C_1^{US}\left(\omega^{US}\right)-\tau^{US}-\left(L^{US-Supply}-\frac{\pi^{US}}{P^{US}\left(b^{US},\omega^{US}\right)}\right)\right]\right\}$$

s.t.

$$w^{US}-C_0^{US}=x^{US}-b^{US}$$

$$x^{US}R^{r^{US}}-\frac{b^{US}R^{US}\left(b^{US},\omega^{US}\right)}{P^{US}\left(b^{US},\omega^{US}\right)}=C_1^{US}\left(\omega^{US}\right)$$

$$b^{US}\geq 0\quad x^{US}\geq 0$$

where $P^{US}\left(b^{US},\omega^{US}\right)=\left[x+(1-x)e^{US}\left(b^{US},\omega^{US}\right)^{\sigma^{US}-1}\right]^{\frac{1}{1-\sigma^{US}}}$.

and

$$\frac{\pi^{US}}{P^{US}\left(b^{US},\omega^{US}\right)}=\frac{\left[x+(1-x)e^{US}\left(b^{US},\omega^{US}\right)^{\sigma^{US}-1}\right]^{\frac{\sigma^{US}}{\sigma^{US}-1}}}{x+(1-x)e^{US}\left(b^{US},\omega^{US}\right)^{\sigma^{US}}}L^{US-Supply}.$$

$R^{r^{US}}$ is the risky asset return for US. w^{US} is the endowment of US. C_0^{US} is the US consumption at $t=0$. $C_1^{US}\left(w^{*}\right)$ is the consumption at $t=1$ which depends on the realization of sunspot. x^{US} is the US investment in the risky asset. $R^{US}\left(b^{US},\omega^{US}\right)$ is the function that maps b^{US} issued at $t=0^{-}$ and the sunspot realization for US into the equilibrium interest rate, and P^{US} is the function that maps b^{US} and sunspot realization into the aggregate price level at $t=1$.

The issuance problem of China is described by the following problem:

$$\max_{x^{CN},b^{CN},C_0^{CN},C_1^{CN}\left(\omega^{CN}\right)}\mathbb{E}^{-}\left\{C_0^{CN}+\delta^{CN}\left[C_1^{CN}\left(\omega^{CN}\right)-\tau^{CN}-\left(L^{CN-Supply}-\frac{\pi^{CN}}{P^{CN}\left(b^{CN},\omega^{CN}\right)}\right)\right]\right\}$$

s.t.

$$w^{CN}-C_0^{CN}=x^{CN}-b^{CN}$$

$$x^{CN}R^{r^{CN}}-\frac{b^{CN}R^{CN}\left(b^{CN},\omega^{CN}\right)}{P^{CN}\left(b^{CN},\omega^{CN}\right)}=C_1^{CN}\left(\omega^{CN}\right)$$

$$b^{CN}\geq 0\quad x^{CN}\geq 0$$

where $P^{CN}\left(b^{CN},\omega^{CN}\right)=\left[ze^{CN}\left(b^{CN},\omega^{CN}\right)^{\sigma^{CN}-1}+(1-z)\right]^{\frac{1}{1-\sigma^{CN}}}$.

and

$$\frac{\pi^{CN}}{P^{CN}\left(b^{CN},\omega^{CN}\right)}=\frac{\left[ze^{CN}\left(b^{CN},\omega^{CN}\right)^{\sigma^{CN}-1}+(1-z)\right]^{\frac{\sigma^{CN}}{\sigma^{CN}-1}}}{ze^{CN}\left(b^{CN},\omega^{CN}\right)^{\sigma^{CN}}+(1-z)}L^{CN-Supply}.$$

$R^{r^{CN}}$ is the risky asset return for China. w^{CN} is the endowment of China. C_0^{CN} is the Chinese consumption at $t=0$. $C_1^{CN}\left(w^*\right)$ is the consumption at $t=1$ which depends on the realization of sunspot. x^{CN} is the Chinese investment in the risky asset. $R^{CN}\left(b^{CN},\omega^{CN}\right)$ is the function that maps b^{CN} issued at $t=0^-$ and the sunspot realization for US into the equilibrium interest rate, and P^{CN} is the function that maps b^{CN} and sunspot realization into the aggregate price level at $t=1$.

A3. Solving Limited-Commitment Equilibrium

A3.1. The Equilibria that Occur for a Given Quantity of Debt *b*

If a disaster has occurred for US at $t=1$, the US decides whether to devalue USD by solving

$$\max_{C_1^{US},e^{US}\in\left\{1,e_L^{US}\right\}} C_1^{US}-\tau^{US}-\left(L^{US-Supply}-\frac{\pi^{US}}{P^{US}}\right)$$

s.t.

$$x^{US}R_L^{US}-\frac{b^{US}R^{US}}{P^{US}}=C_1^{US}$$

where $P^{US}=\left[x+(1-x)e^{US^{\sigma^{US}-1}}\right]^{\frac{1}{1-\sigma^{US}}}$.

and

$$\frac{\pi^{US}}{P^{US}}=\frac{\left[x+(1-x)e^{US^{\sigma^{US}-1}}\right]^{\frac{\sigma^{US}}{\sigma^{US}-1}}}{x+(1-x)e^{US^{\sigma^{US}}}}L^{US-Supply}.$$

Therefore, the USD is devalued if $-b^{US}R^{US}+L^{US-Supply}\leq-\frac{b^{US}R^{US}}{P_L^{US}}+\frac{\pi_L^{US}}{P_L^{US}}-\tau^{US}$, which results in $\underline{b}^{US}$ given b^{CN}. If $-b^{US}R^{US}+L^{US-Supply}>-\frac{b^{US}R^{US}}{P_L^{US}}+\frac{\pi_L^{US}}{P_L^{US}}-\tau^{US}$, which results $\bar{b}^{US}$ given b^{CN}, which results in $\bar{b}^{US}$ given b^{CN}.

Therefore, I obtain the three zones for US: given b^{CN}, the safety zone is $b^{US}\in\left[0,\underline{b}^{US}\right]$; the instability zone is $b^{US}\in\left(\underline{b}^{US},\bar{b}^{US}\right]$; the collapse zone is $b^{US}\in\left(\bar{b}^{US},w^*\right]$.

If a disaster has occurred for China at $t=1$, the US decides whether to devalue USD by solving

$$\max_{C_1^{CN}, e^{CN} \in \{1, e_L^{CN}\}} C_1^{CN} - \tau^{CN} - \left(L^{CN-Supply} - \frac{\pi^{CN}}{P^{CN}}\right)$$

s.t.

$$x^{CN} R_L^{CN} - \frac{b^{CN} R^{CN}}{P^{CN}} = C_1^{CN}$$

where $P^{CN} = \left[z e^{CN^{\sigma^{CN}-1}} + (1-z) \right]^{\frac{1}{1-\sigma^{CN}}}$.

and

$$\frac{\pi^{CN}}{P^{CN}} = \frac{\left[z e^{CN^{\sigma^{CN}-1}} + (1-z) \right]^{\frac{\sigma^{CN}}{\sigma^{CN}-1}}}{z e^{CN^{\sigma^{CN}}} + (1-z)} L^{CN-Supply}.$$

Therefore, the RMB is devalued if $-b^{CN} R^{CN} + L^{CN-Supply} \le -\frac{b^{CN} R^{CN}}{P_L^{CN}} + \frac{\pi_L^{CN}}{P_L^{CN}} - \tau^{CN}$, which results in $\underline{b}^{CN}$ given b^{US}. If $-b^{CN} R^{CN} + L^{CN-Supply} > -\frac{b^{CN} R^{CN}}{P_L^{CN}} + \frac{\pi_L^{CN}}{P_L^{CN}} - \tau^{CN}$, which results $\bar{b}^{CN}$ given b^{US}, which results in $\bar{b}^{CN}$ given b^{US}.

Therefore, I obtain the three zones for US: given b^{US}, the safety zone is $b^{CN} \in \left[0, \underline{b}^{CN}\right]$; the instability zone is $b^{CN} \in \left(\underline{b}^{CN}, \bar{b}^{CN}\right]$; the collapse zone is $b^{CN} \in \left(\bar{b}^{CN}, w^*\right]$.

A3.2. The Optimal Issuance of b^{US} and b^{CN} under Limited Commitment

According to Farhi and Maggiori (2018), the issuance problem for US under full commitment is described by

$$\max_{b^{US} \ge 0} V^{US}\left(b^{US}\right) = b^{US}\left(\bar{R}^r - R^{US}\left(b^{US}\right)\right)$$

And the optimal issuance $b^{US} = \frac{1}{2} w^*$.

Likewise, the issuance problem for China under full commitment is described by

$$\max_{b^{CN} \ge 0} V^{CN}\left(b^{CN}\right) = b^{CN}\left(\bar{R}^r - R^{CN}\left(b^{CN}\right)\right)$$

And the optimal issuance $b^{CN} = \frac{1}{2} w^*$.

Define a function $\alpha\left(b^{US}\right) \in [0,1]$ to denote the $t=0^-$ probability that the continuation equilibrium of US for $t=0^+$ onward is the collapse equilibrium

$$\alpha\left(b^{US}\right) = \begin{cases} 0 & \text{for } b^{US} \in \left[0, \underline{b}^{US}\right] \\ \alpha^{US} & \text{for } b^{US} \in \left(\underline{b}^{US}, \bar{b}^{US}\right] \\ 1 & \text{for } b^{US} \in \left(\bar{b}^{US}, w^*\right] \end{cases}$$

Define a function $\alpha\left(b^{CN}\right)\in\left[0,1\right]$ to denote the $t=0^{-}$ probability that the continuation equilibrium of China for $t=0^{+}$ onward is the collapse equilibrium

$$\alpha\left(b^{CN}\right)=\begin{cases}0 & \text{for } b^{CN}\in\left[0,\underline{b}^{CN}\right]\\ \alpha^{CN} & \text{for } b^{CN}\in\left(\underline{b}^{CN},\overline{b}^{CN}\right]\\ 1 & \text{for } b^{CN}\in\left(\overline{b}^{CN},w^{*}\right]\end{cases}$$

Therefore, referring to the formulation of the full-commitment problems, given b^{CN}, the issuance problem of US is described by

$$\max_{b^{US}\geq 0} U^{US}\left(b^{US}\right)=\left(1-\alpha\left(b^{US}\right)\right)V^{US}\left(b^{US}\right)-\alpha\left(b^{US}\right)\lambda^{US}\tau^{US}$$

And given b^{US}, the issuance problem of China is described by

$$\max_{b^{CN}\geq 0} U^{CN}\left(b^{CN}\right)=\left(1-\alpha\left(b^{CN}\right)\right)V^{CN}\left(b^{CN}\right)-\alpha\left(b^{CN}\right)\lambda^{CN}\tau^{CN}$$

According to the formulation of the value functions under limited commitment, for US, there exists an $\alpha_b^{US}\in\left(0,1\right)$ such that $\left(1-\alpha_b^{US}\right)V^{US}\left(\frac{1}{2}w^{*}\right)-\alpha_b^{US}\lambda^{US}\tau^{US}=\left(1-\alpha_b^{US}\right)V^{US}\left(\underline{b}^{US}\right)-\alpha_b^{US}\lambda^{US}\tau^{US}$. For China, there exists an $\alpha_b^{CN}\in\left(0,1\right)$ such that $\left(1-\alpha_b^{CN}\right)V^{CN}\left(\frac{1}{2}w^{*}\right)-\alpha_b^{CN}\lambda^{CN}\tau^{CN}=\left(1-\alpha_b^{CN}\right)V^{CN}\left(\underline{b}^{CN}\right)-\alpha_b^{CN}\lambda^{CN}\tau^{CN}$. I use Figure A1 to describe the value function for US when $\alpha^{US}=\alpha_b^{US}$, given b^{CN}.

Therefore, for $\alpha^{US}>\alpha_b^{US}$, the US will issue $\underline{b}^{US}$ given b^{CN}. Likewise, for $\alpha^{CN}>\alpha_b^{CN}$, China will issue $\underline{b}^{CN}$ given b^{US}.

Further, both the α_b^{US} when $b^{CN}=\underline{b}^{CN}$ and the α_b^{CN} when $b^{US}=\underline{b}^{US}$ can be obtained. These thresholds are those I refer to in the main context of the paper.

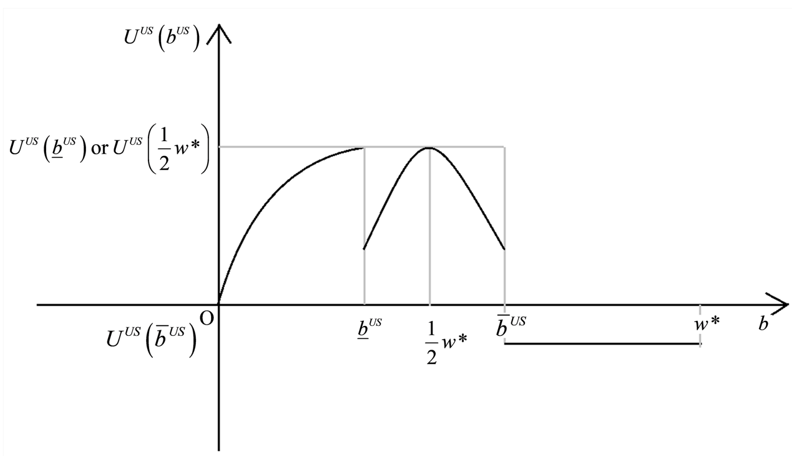

Figure A1. The value function of US under limited commitment when $\alpha^{US}=\alpha_b^{US}$, given b^{CN}.

Appendix B. Derivation of Best Response Functions

Reformulate the first and second equations in (9), I obtain that

$$\underline{b}^{US^2}+\left[\underline{b}^{CN}-\frac{1-\lambda^{US}}{\bar{R}^r\left(1-\frac{\lambda^{US}}{P_L^{US}}\right)\left(1-\frac{1}{P_L^{US}}\right)}\tau_{US}^{US}\right]\times\underline{b}^{US}-\frac{1-\lambda}{\bar{R}^r\left(1-\frac{\lambda^{US}}{P_L^{US}}\right)\left(1-\frac{1}{P_L^{US}}\right)}\tau_{US}^{CN}\underline{b}^{CN}=0 \tag{B.1}$$

and

$$\underline{b}^{CN^2}+\left[\underline{b}^{US}-\frac{1-\lambda^{CN}}{\bar{R}^r\left(1-\frac{\lambda^{CN}}{P_L^{CN}}\right)\left(1-\frac{1}{P_L^{CN}}\right)}\tau_{CN}^{CN}\right]\times\underline{b}^{CN}-\frac{1-\lambda}{\bar{R}^r\left(1-\frac{\lambda^{CN}}{P_L^{CN}}\right)\left(1-\frac{1}{P_L^{CN}}\right)}\tau_{CN}^{US}\underline{b}^{US}=0 \tag{B.2}$$

respectively. Solving (B.1), I obtain two solutions

$$\min\underline{b}^{US}=\frac{-\left(\underline{b}^{CN}-A^{US}\tau_{US}^{US}\right)-\sqrt{\left(\underline{b}^{CN}-A^{US}\tau_{US}^{US}\right)^2+4A^{US}\tau_{US}^{CN}\underline{b}^{CN}}}{2}<0$$

and

$$\max\underline{b}^{US}=\frac{-\left(\underline{b}^{CN}-A^{US}\tau_{US}^{US}\right)+\sqrt{\left(\underline{b}^{CN}-A^{US}\tau_{US}^{US}\right)^2+4A^{US}\tau_{US}^{CN}\underline{b}^{CN}}}{2}>0$$

Because only $\max\underline{b}^{US}$ is positive, therefore the best response function of US takes the positive solution of Equation (B.1).

Solving (B.2), I obtain two solutions

$$\min\underline{b}^{CN}=\frac{-\left(\underline{b}^{US}-A^{CN}\tau_{CN}^{CN}\right)-\sqrt{\left(\underline{b}^{US}-A^{CN}\tau_{CN}^{CN}\right)^2+4A^{CN}\tau_{CN}^{US}\underline{b}^{US}}}{2}<0$$

and

$$\max\underline{b}^{CN}=\frac{-\left(\underline{b}^{US}-A^{CN}\tau_{CN}^{CN}\right)+\sqrt{\left(\underline{b}^{US}-A^{CN}\tau_{CN}^{CN}\right)^2+4A^{CN}\tau_{CN}^{US}\underline{b}^{US}}}{2}>0$$

Because only $\max\underline{b}^{CN}$ is positive, therefore the best response function of China takes the positive solution of Equation (B.2).

Appendix C. The Monotonicity of Best Response Functions (The Strategic Impact of Opponent's Safe Asset Issuance on a Country's Own Safe Asset Issuance)

To obtain the monotonicity of the US best response function, I obtain that

$$\frac{\partial \underline{b}^{US}}{\partial \underline{b}^{CN}} = \frac{1}{2} \times \left\{ -1 + \frac{1}{2} \times \frac{2 \times \left(\underline{b}^{CN} - A^{US} \tau_{US}^{US} \right) + 4 A^{US} \tau_{US}^{CN}}{\sqrt{\left(\underline{b}^{CN} - A^{US} \tau_{US}^{US} \right)^2 + 4 A^{US} \tau_{US}^{CN} \underline{b}^{CN}}} \right\}$$

Given $\underline{b}^{CN} \geq A^{US} \times \left(\tau_{US}^{US} - 2\tau_{US}^{CN} \right)$, $-1 + \frac{1}{2} \times \frac{2 \times \left(\underline{b}^{CN} - A^{US} \tau_{US}^{US} \right) + 4 A^{US} \tau_{US}^{CN}}{\sqrt{\left(\underline{b}^{CN} - A^{US} \tau_{US}^{US} \right)^2 + 4 A^{US} \tau_{US}^{CN} \underline{b}^{CN}}} > 0$ is equivalently reformulated to $\tau_{US}^{CN} \left(\tau_{US}^{CN} - \tau_{US}^{US} \right) > 0$. Therefore, given $\underline{b}^{CN} \geq A^{US} \times \left(\tau_{US}^{US} - 2\tau_{US}^{CN} \right)$, $\tau_{US}^{CN} \gtrless \tau_{US}^{US} \Leftrightarrow \frac{\partial \underline{b}^{US}}{\partial \underline{b}^{CN}} \gtrless 0$. In addition, for $\underline{b}^{CN} < A^{US} \times \left(\tau_{US}^{US} - 2\tau_{US}^{CN} \right)$, $\frac{\partial \underline{b}^{US}}{\partial \underline{b}^{CN}} < 0$.

To obtain the monotonicity of China best response function, I obtain that

$$\frac{\partial \underline{b}^{CN}}{\partial \underline{b}^{US}} = \frac{1}{2} \times \left\{ -1 + \frac{1}{2} \times \frac{2 \times \left(\underline{b}^{US} - A^{CN} \tau_{CN}^{CN} \right) + 4 A^{CN} \tau_{CN}^{US}}{\sqrt{\left(\underline{b}^{US} - A^{CN} \tau_{CN}^{CN} \right)^2 + 4 A^{CN} \tau_{CN}^{US} \underline{b}^{US}}} \right\}$$

Given $\underline{b}^{US} \geq A^{CN} \times \left(\tau_{CN}^{CN} - 2\tau_{CN}^{US} \right)$, $-1 + \frac{1}{2} \times \frac{2 \times \left(\underline{b}^{US} - A^{CN} \tau_{CN}^{CN} \right) + 4 A^{CN} \tau_{CN}^{US}}{\sqrt{\left(\underline{b}^{US} - A^{CN} \tau_{CN}^{CN} \right)^2 + 4 A^{CN} \tau_{CN}^{US} \underline{b}^{US}}} > 0$ is equivalently reformulated to $\tau_{CN}^{US} \left(\tau_{CN}^{US} - \tau_{CN}^{CN} \right) > 0$. Therefore, given $\underline{b}^{US} \geq A^{CN} \times \left(\tau_{CN}^{CN} - 2\tau_{CN}^{US} \right)$, $\tau_{CN}^{US} \gtrless \tau_{CN}^{CN} \Leftrightarrow \frac{\partial \underline{b}^{CN}}{\partial \underline{b}^{US}} \gtrless 0$. In addition, for $\underline{b}^{US} < A^{CN} \times \left(\tau_{CN}^{CN} - 2\tau_{CN}^{US} \right)$, $\frac{\partial \underline{b}^{CN}}{\partial \underline{b}^{US}} < 0$.

Because $\tau_{US}^{US} < \tau_{US}^{CN}$, therefore $\tau_{US}^{US} < \tau_{US}^{CN} < 2\tau_{US}^{CN}$. Therefore, for $\underline{b}^{CN} \geq 0$, $\frac{\partial \underline{b}^{US}}{\partial \underline{b}^{CN}} > 0$.

Now assume $\tau_{CN}^{CN} > 2\tau_{CN}^{US}$. Therefore, for $\underline{b}^{US} \geq A^{CN} \times \left(\tau_{CN}^{CN} - 2\tau_{CN}^{US} \right)$, $\frac{\partial \underline{b}^{CN}}{\partial \underline{b}^{US}} < 0$. It is known that for $\underline{b}^{US} < A^{CN} \times \left(\tau_{CN}^{CN} - 2\tau_{CN}^{US} \right)$, $\frac{\partial \underline{b}^{CN}}{\partial \underline{b}^{US}} < 0$. Therefore, given $\tau_{CN}^{CN} > 2\tau_{CN}^{US}$, for $\underline{b}^{US} \geq 0$, $\frac{\partial \underline{b}^{CN}}{\partial \underline{b}^{US}} < 0$.

Then assume $\tau_{CN}^{CN} < 2\tau_{CN}^{US}$, which implies that $\tau_{CN}^{US} < \tau_{CN}^{CN} < 2\tau_{CN}^{US}$ (note that it has been implicitly assumed that $\tau_{CN}^{US} < \tau_{CN}^{CN}$). Therefore, for $\underline{b}^{US} \geq 0$, if $\tau_{CN}^{US} < \tau_{CN}^{CN} < 2\tau_{CN}^{US}$, $\frac{\partial \underline{b}^{CN}}{\partial \underline{b}^{US}} < 0$.

Therefore, for $\tau_{CN}^{CN} > \tau_{CN}^{US}$, $\frac{\partial \underline{b}^{CN}}{\partial \underline{b}^{US}} < 0$.

Likewise, following the same procedures in the above, it can obtained that for $\tau_{US}^{US} > \tau_{US}^{CN}$, $\frac{\partial \underline{b}^{US}}{\partial \underline{b}^{CN}} < 0$, and for $\tau_{CN}^{CN} < \tau_{CN}^{US}$, $\frac{\partial \underline{b}^{CN}}{\partial \underline{b}^{US}} > 0$.

Appendix D. Derivation of the Equilibrium

First, I will derive the equilibrium debt issuance of US. Putting the second Equation in (10) into (B.1) and reformulating the obtained equation, I obtain that

$$\begin{aligned}&\left[A^{CN}\left(\tau_{CN}^{CN}-\tau_{CN}^{US}\right)+A^{US}\left(\tau_{US}^{CN}-\tau_{US}^{US}\right)\right]\times \underline{b}^{US^2}\\&+A^{US}\times\left[\left(2A^{CN}\tau_{CN}^{US}-A^{US}\tau_{US}^{US}-A^{CN}\tau_{CN}^{CN}\right)\tau_{US}^{CN}+\left(A^{US}\tau_{US}^{US}-A^{CN}\tau_{CN}^{CN}\right)\tau_{US}^{US}\right]\times \underline{b}^{US}\\&+\left(A^{US}\right)^2\times A^{CN}\times\tau_{US}^{CN}\times\left(\tau_{US}^{US}\tau_{CN}^{CN}-\tau_{US}^{CN}\tau_{CN}^{US}\right)=0\end{aligned}$$

Solving the above quadratic equation, I obtain that

$$\underline{b}^{US}=A^{US}\left\{\frac{-\left[\left(2A^{CN}\tau_{CN}^{US}-A^{US}\tau_{US}^{US}-A^{CN}\tau_{CN}^{CN}\right)\tau_{US}^{CN}+\left(A^{US}\tau_{US}^{US}-A^{CN}\tau_{CN}^{CN}\right)\tau_{US}^{US}\right]}{2\left[A^{CN}\left(\tau_{CN}^{CN}-\tau_{CN}^{US}\right)+A^{US}\left(\tau_{US}^{CN}-\tau_{US}^{US}\right)\right]}\right.$$
$$\left.\pm\frac{\sqrt{\left[\left(2A^{CN}\tau_{CN}^{US}-A^{US}\tau_{US}^{US}-A^{CN}\tau_{CN}^{CN}\right)\tau_{US}^{CN}+\left(A^{US}\tau_{US}^{US}-A^{CN}\tau_{CN}^{CN}\right)\tau_{US}^{US}\right]^2-4\left[A^{CN}\left(\tau_{CN}^{CN}-\tau_{CN}^{US}\right)+A^{US}\left(\tau_{US}^{CN}-\tau_{US}^{US}\right)\right]\times A^{CN}\times\tau_{US}^{CN}\times\left(\tau_{US}^{US}\tau_{CN}^{CN}-\tau_{US}^{CN}\tau_{CN}^{US}\right)}}{2\left[A^{CN}\left(\tau_{CN}^{CN}-\tau_{CN}^{US}\right)+A^{US}\left(\tau_{US}^{CN}-\tau_{US}^{US}\right)\right]}\right\}$$

Note that if $\tau_{US}^{CN}=\tau_{US}^{US}$, then $\tau_{US}^{CN}=\tau_{US}^{US}=\tau^{US}$ and $\underline{b}^{US}=\tau_{US}A^{US}$, which is just the devaluation threshold of US in Farhi and Maggiori (2019).

Second, I will derive equilibrium debt issuance of China. Putting the first equation in (10) into (B.2) and reformulating the obtained equation, I obtain that

$$\begin{aligned}&\left[A^{US}\left(\tau_{US}^{US}-\tau_{US}^{CN}\right)+A^{CN}\left(\tau_{CN}^{US}-\tau_{CN}^{CN}\right)\right]\times \underline{b}^{CN^2}\\&+A^{CN}\times\left[\left(2A^{US}\tau_{US}^{CN}-A^{CN}\tau_{CN}^{CN}-A^{US}\tau_{US}^{US}\right)\tau_{CN}^{US}+\left(A^{CN}\tau_{US}^{CN}-A^{US}\tau_{US}^{US}\right)\tau_{CN}^{CN}\right]\times \underline{b}^{CN}\\&+\left(A^{CN}\right)^2\times A^{US}\times\tau_{CN}^{US}\times\left(\tau_{CN}^{CN}\tau_{US}^{US}-\tau_{CN}^{US}\tau_{US}^{CN}\right)=0\end{aligned}$$

Solving the above quadratic equation, I obtain that

$$\underline{b}^{CN}=A^{CN}\left\{\frac{-\left[\left(2A^{US}\tau_{US}^{CN}-A^{CN}\tau_{CN}^{CN}-A^{US}\tau_{US}^{US}\right)\tau_{CN}^{US}+\left(A^{CN}\tau_{CN}^{CN}-A^{US}\tau_{US}^{US}\right)\tau_{CN}^{CN}\right]}{2\left[A^{US}\left(\tau_{US}^{US}-\tau_{US}^{CN}\right)+A^{CN}\left(\tau_{CN}^{US}-\tau_{CN}^{CN}\right)\right]}\right.$$
$$\left.\pm\frac{\sqrt{\left[\left(2A^{US}\tau_{US}^{CN}-A^{CN}\tau_{CN}^{CN}-A^{US}\tau_{US}^{US}\right)\tau_{CN}^{US}+\left(A^{CN}\tau_{CN}^{CN}-A^{US}\tau_{US}^{US}\right)\tau_{CN}^{CN}\right]^2-4\left[A^{US}\left(\tau_{US}^{US}-\tau_{US}^{CN}\right)+A^{CN}\left(\tau_{CN}^{US}-\tau_{CN}^{CN}\right)\right]\times A^{US}\times\tau_{CN}^{US}\times\left(\tau_{CN}^{CN}\tau_{US}^{US}-\tau_{CN}^{US}\tau_{US}^{CN}\right)}}{2\left[A^{US}\left(\tau_{US}^{US}-\tau_{US}^{CN}\right)+A^{CN}\left(\tau_{CN}^{US}-\tau_{CN}^{CN}\right)\right]}\right\}$$

Note that if $\tau_{CN}^{US}=\tau_{CN}^{CN}$, then $\tau_{CN}^{US}=\tau_{CN}^{CN}=\tau^{CN}$ and $\underline{b}^{CN}=\tau_{CN}A^{CN}$.

Given the specification $\tau_{US}^{US}<\tau_{US}^{CN}$, $\tau_{CN}^{CN}>\tau_{CN}^{US}$, and $\tau_{US}^{US}\tau_{CN}^{CN}=\tau_{US}^{CN}\tau_{CN}^{US}$ in the main context, $\underline{b}^{US}$ and $\underline{b}^{CN}$ are respectively reduced to

$$\begin{cases}\underline{b}^{US}=A^{US}\times\dfrac{A^{CN}\left(\tau_{CN}^{CN}-\tau_{CN}^{US}\right)\tau_{US}^{CN}+A^{US}\left(\tau_{US}^{CN}-\tau_{US}^{US}\right)\tau_{US}^{US}}{A^{CN}\left(\tau_{CN}^{CN}-\tau_{CN}^{US}\right)+A^{US}\left(\tau_{US}^{CN}-\tau_{US}^{US}\right)}\\[2ex]\underline{b}^{CN}=A^{CN}\times\dfrac{A^{CN}\left(\tau_{CN}^{CN}-\tau_{CN}^{US}\right)\tau_{CN}^{CN}+A^{US}\left(\tau_{US}^{CN}-\tau_{US}^{US}\right)\tau_{CN}^{US}}{A^{CN}\left(\tau_{CN}^{CN}-\tau_{CN}^{US}\right)+A^{US}\left(\tau_{US}^{CN}-\tau_{US}^{US}\right)}\end{cases}$$

i.e.

$$\begin{cases}\underline{b}^{US}=A^{US}\times\tau_{A}^{US}\\\underline{b}^{CN}=A^{CN}\times\tau_{A}^{CN}\end{cases}$$

where $\tau_A^{US} = \frac{A^{CN}\left(\tau_{CN}^{CN} - \tau_{CN}^{US}\right)\tau_{US}^{CN} + A^{US}\left(\tau_{US}^{CN} - \tau_{US}^{US}\right)\tau_{US}^{US}}{A^{CN}\left(\tau_{CN}^{CN} - \tau_{CN}^{US}\right) + A^{US}\left(\tau_{US}^{CN} - \tau_{US}^{US}\right)}$ and $\tau_A^{CN} = \frac{A^{CN}\left(\tau_{CN}^{CN} - \tau_{CN}^{US}\right)\tau_{CN}^{CN} + A^{US}\left(\tau_{US}^{CN} - \tau_{US}^{US}\right)\tau_{CN}^{US}}{A^{CN}\left(\tau_{CN}^{CN} - \tau_{CN}^{US}\right) + A^{US}\left(\tau_{US}^{CN} - \tau_{US}^{US}\right)}$.

Appendix E. The Impact of the Share of USD Pricing and Invoicing in US and China on the Equilibrium Devaluation Thresholds $\underline{b}^{US}$ and $\underline{b}^{CN}$

According to the expressions of the equilibrium devaluation threshold $\underline{b}^{US}$ and $\underline{b}^{CN}$, it can be obtained that

$$\frac{\partial \underline{b}^{US}}{\partial x} = \frac{\partial \underline{b}^{US}}{\partial A^{US}} \frac{\partial A^{US}}{\partial P_L^{US}} \frac{\partial P_L^{US}}{\partial x}$$

$$\frac{\partial \underline{b}^{CN}}{\partial x} = \frac{\partial \underline{b}^{CN}}{\partial A^{US}} \frac{\partial A^{US}}{\partial P_L^{US}} \frac{\partial P_L^{US}}{\partial x}$$

$$\frac{\partial \underline{b}^{CN}}{\partial z} = \frac{\partial \underline{b}^{CN}}{\partial A^{CN}} \frac{\partial A^{CN}}{\partial P_L^{CN}} \frac{\partial P_L^{CN}}{\partial z}$$

$$\frac{\partial \underline{b}^{US}}{\partial z} = \frac{\partial \underline{b}^{US}}{\partial A^{CN}} \frac{\partial A^{CN}}{\partial P_L^{CN}} \frac{\partial P_L^{CN}}{\partial z}$$

It can be obtained that

$$\frac{\partial \underline{b}^{US}}{\partial A^{US}} = \left[\frac{1}{A^{US}} + \frac{\tau_{US}^{US}\left(\tau_{US}^{CN} - \tau_{US}^{US}\right)}{A^{CN}\tau_{US}^{CN}\left(\tau_{CN}^{CN} - \tau_{CN}^{US}\right) + A^{US}\tau_{US}^{US}\left(\tau_{US}^{CN} - \tau_{US}^{US}\right)} - \frac{\tau_{US}^{CN} - \tau_{US}^{US}}{A^{CN}\left(\tau_{CN}^{CN} - \tau_{US}^{US}\right) + A^{US}\left(\tau_{US}^{CN} - \tau_{US}^{US}\right)}\right] \times \underline{b}^{US} > 0$$

and

$$\frac{\partial \underline{b}^{CN}}{\partial A^{CN}} = \left[\frac{1}{A^{CN}} + \frac{\tau_{CN}^{CN}\left(\tau_{CN}^{CN} - \tau_{CN}^{US}\right)}{A^{CN}\tau_{CN}^{CN}\left(\tau_{CN}^{CN} - \tau_{CN}^{US}\right) + A^{US}\tau_{CN}^{US}\left(\tau_{US}^{CN} - \tau_{US}^{US}\right)} - \frac{\tau_{CN}^{CN} - \tau_{CN}^{US}}{A^{CN}\left(\tau_{CN}^{CN} - \tau_{CN}^{US}\right) + A^{US}\left(\tau_{US}^{CN} - \tau_{US}^{US}\right)}\right] \times \underline{b}^{CN} > 0$$

Given the specification $\tau_{US}^{CN} > \tau_{US}^{US}$ and $\tau_{CN}^{CN} > \tau_{CN}^{US}$, it can be obtained that

$$\frac{\partial \underline{b}^{US}}{\partial A^{CN}} = \left[\frac{\tau_{US}^{CN}\left(\tau_{CN}^{CN} - \tau_{CN}^{US}\right)}{A^{CN}\tau_{US}^{CN}\left(\tau_{CN}^{CN} - \tau_{CN}^{US}\right) + A^{US}\tau_{US}^{US}\left(\tau_{US}^{CN} - \tau_{US}^{US}\right)} - \frac{\tau_{CN}^{CN} - \tau_{CN}^{US}}{A^{CN}\left(\tau_{CN}^{CN} - \tau_{CN}^{US}\right) + A^{US}\left(\tau_{US}^{CN} - \tau_{US}^{US}\right)}\right] \underline{b}^{US} > 0$$

and

$$\frac{\partial \underline{b}^{CN}}{\partial A^{US}}=\left[\frac{\tau_{CN}^{US}\left(\tau_{US}^{CN}-\tau_{US}^{US}\right)}{A^{CN}\tau_{CN}^{CN}\left(\tau_{CN}^{CN}-\tau_{CN}^{US}\right)+A^{US}\tau_{CN}^{US}\left(\tau_{US}^{CN}-\tau_{US}^{US}\right)}-\frac{\tau_{US}^{CN}-\tau_{US}^{US}}{A^{CN}\left(\tau_{CN}^{CN}-\tau_{CN}^{US}\right)+A^{US}\left(\tau_{US}^{CN}-\tau_{US}^{US}\right)}\right]\underline{b}^{CN}>0$$

In addition, the following results can be derived

$$\frac{\partial A^{US}}{\partial P_L^{US}}=-\frac{A^{US}}{P_L^{US}}\left(\frac{\lambda^{US}}{P_L^{US}-\lambda^{US}}+\frac{1}{P_L^{US}-1}\right)<0$$

$$\frac{\partial A^{CN}}{\partial P_L^{CN}}=-\frac{A^{CN}}{P_L^{CN}}\left(\frac{\lambda^{CN}}{P_L^{CN}-\lambda^{CN}}+\frac{1}{P_L^{CN}-1}\right)<0$$

$$\frac{\partial P_L^{US}}{\partial x}=\frac{1}{1-\sigma^{US}}\left[x+(1-x)e_L^{USD^{\sigma^{US}-1}}\right]^{\frac{\sigma^{US}}{\sigma^{US}-1}}\left(1-e_L^{USD^{\sigma^{US}-1}}\right)<0$$

for $\sigma^{US}\neq 1$. If $\sigma^{US}=1$, then $P_L^{US}=1$ and hence $\frac{\partial P_L^{US}}{\partial x}=0$, which is a trivial case that is excluded from the discussion of this paper.

$$\frac{\partial P_L^{CN}}{\partial z}=\frac{1}{1-\sigma^{CN}}\left[ze_L^{RMB^{\sigma^{CN}-1}}+(1-z)\right]^{\frac{\sigma^{CN}}{\sigma^{CN}-1}}\left(1-e_L^{RMB^{\sigma^{CN}-1}}\right)>0$$

for $\sigma^{CN}\neq 1$. If $\sigma^{CN}=1$, then $P_L^{CN}=1$ and hence $\frac{\partial P_L^{CN}}{\partial z}=0$, which is a trivial case that is excluded from the discussion of this paper.

Therefore, it can be obtained that $\frac{\partial \underline{b}^{US}}{\partial x}>0$, $\frac{\partial \underline{b}^{CN}}{\partial x}<0$, $\frac{\partial \underline{b}^{CN}}{\partial z}<0$ and $\frac{\partial \underline{b}^{US}}{\partial z}<0$.

Appendix F. The Impact of Expected Degree of Both Countries' Currency Devaluation on Their Devaluation Thresholds

According to the expressions of $\underline{b}^{US}$ and $\underline{b}^{CN}$, the following results can be derived:

$$\frac{\partial \underline{b}^{US}}{\partial e_L^{US}}=\frac{\partial \underline{b}^{US}}{\partial A^{US}}\frac{\partial A^{US}}{\partial P_L^{US}}\frac{\partial P_L^{US}}{\partial e_L^{US}}$$

$$\frac{\partial \underline{b}^{CN}}{\partial e_L^{US}}=\frac{\partial \underline{b}^{CN}}{\partial A^{US}}\frac{\partial A^{US}}{\partial P_L^{US}}\frac{\partial P_L^{US}}{\partial e_L^{US}}$$

$$\frac{\partial \underline{b}^{CN}}{\partial e_L^{CN}}=\frac{\partial \underline{b}^{CN}}{\partial A^{CN}}\frac{\partial A^{CN}}{\partial P_L^{CN}}\frac{\partial P_L^{CN}}{\partial e_L^{CN}}$$

$$\frac{\partial \underline{b}^{US}}{\partial e_L^{CN}}=\frac{\partial \underline{b}^{US}}{\partial A^{CN}}\frac{\partial A^{CN}}{\partial P_L^{CN}}\frac{\partial P_L^{CN}}{\partial e_L^{CN}}$$

Here, the valuation of e_L^{US} and e_L^{CN} reflect the expected degree of devaluation of USD and RMB respectively in case US and China devalue their home currencies in their respective disaster states. It can be obtained that $\frac{\partial P_L^{US}}{\partial e_L^{US}} = -(1-x)\left[x+(1-x)e_L^{USD^{\sigma^{US}-1}}\right]^{\frac{\sigma^{US}}{1-\sigma^{US}}} e_L^{USD^{\sigma^{US}-2}} < 0$ and $\frac{\partial P_L^{CN}}{\partial e_L^{CN}} = -z\left[ze_L^{RMB^{\sigma^{CN}-1}}+(1-z)\right]^{\frac{\sigma^{CN}}{1-\sigma^{CN}}} e_L^{RMB^{\sigma^{CN}-2}} < 0$. Therefore, combining the derived results in the last section, I obtain the following results $\frac{\partial \underline{b}^{US}}{\partial e_L^{US}} > 0$, $\frac{\partial \underline{b}^{CN}}{\partial e_L^{US}} < 0$, $\frac{\partial \underline{b}^{CN}}{\partial e_L^{CN}} > 0$ and $\frac{\partial \underline{b}^{US}}{\partial e_L^{CN}} > 0$.