PUBLIC DEBT STABILITY IN THE PEOPLE'S REPUBLIC OF CHINA

RETHINKING THE DOMAR CONDITION AND ITS BOND MARKET APPLICATION

Naoyuki Yoshino, Akiko Terada-Hagiwara, and Hiroaki Miyamoto

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and Hiroaki Miyamoto

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ABBREVIATIONS

GDP	gross domestic product
NTR	nontax revenues
PRC	People's Republic of China
TRN	transfer from central government to local government
US	United States

ABSTRACT

This paper extends the supply side argument of the Domar model for fiscal sustainability. The authors find that public debt sustainability depends on the sensitivity of interest rates to changes in government bond supply and demand. This is true in the case of the People's Republic of China, Greece, and Japan. This modified fiscal sustainability condition suggests that the opening of capital markets to nonresident investors is important together with stability of the bond market. The opening, however, needs to be done cautiously and must consider how quickly overseas investors can move away from the market compared to domestic investors.

I. INTRODUCTION

Fiscal sustainability is a central consideration in fiscal policy analysis. The coronavirus disease (COVID-19) pandemic has pushed many countries to provide government emergency spending to those who have been affected by business shutdowns. Huge spending means huge increases in government debt, which might trigger the danger of debt explosion.

The debate on public debt sustainability often relies on a condition proposed by Domar (1944), which says that for debt to be sustainable, the current nominal gross domestic product (GDP) rate should exceed the current interest rate on public debt. This is obtained from the government budget constraint, which focuses only on the supply of government bonds and does not take into account the demand for government bonds. Krugman (2020) argues, based on the Domar condition, that fiscal explosion can be avoided since many countries face very low or sometimes negative interest rates that are lower than the growth rate of the economy.

This setup may be applicable to countries that issue bonds with stable demand, such as the United States (US), where demand for US dollar-denominated bond comes from all over the world. Especially when facing economic crises, the US government bonds attract many investors as a safe haven. However, many countries do not issue US dollar-denominated bonds. Furthermore, local currency bonds face limited demand. Thus, it may not be appropriate to use the Domar condition in these countries.

Yoshino and Miyamoto (2020) revisit the Domar condition by considering the demand for government bonds together with the supply of government bonds. They show that a stability condition for government budgets would be different from what Domar (1944) suggested once the demand for government bonds is taken into account. They find that public debt stability depends on interest rate sensitivity to changes in government bond supply and demand. If an increase in the interest rate to supply one more unit of government bond is higher than that of demand, the interest burden of bond supply becomes larger than the demand side. Thus, the government has to pay a higher interest rate, which leads to explosion of budget deficits. In contrast, if an increase in the interest rate from the demand side is higher than that of the supply side, buyers would pay more to purchase one unit of the government bond, and the interest burden for the government will decline. Thus, the stability of budget will be achieved. This claim is supported by an empirical investigation of the cases in Greece and Japan. Yoshino and Miyamoto affirm their finding on fiscal sustainability, in that while Greece went bankrupt, Japan's fiscal position was still sustainable although Japan's debt-to-GDP ratio was higher than that of Greece. This result is explained by the difference on the demand side of the countries' government bonds.

This paper extends Yoshino and Miyamoto (2020) by adding local governments into the picture to examine how the sustainability condition may be affected. Particular attention is paid to the People's Republic of China (PRC). The paper finds that fiscal sustainability of local governments provided by the central government will remain the same even if transfer payments were allocated. The budget will remain stable as long as the interest sensitivity of the government bond supply is smaller than that of government bond demand. The Domar condition of comparing the interest rate and the growth rate of the economy does not apply to the central government or to the local government.

II. THE DOMAR CONDITION WITH CONSTRAINED DEMAND

The Domar condition is well known to determine whether a budget deficit is sustainable. The Domar condition is obtained from the government budget constraint. Under the condition where the primary balance is in equilibrium, if the interest rate exceeds GDP growth, the budget deficit will increase. In contrast, if the interest rate is lower than the growth rate, the budget deficit will converge in a stable manner. However, as the government budget constraint focuses only on the supply of government bonds, the Domar condition does not consider the demand for government bonds.

In order to consider the demand for government bonds, Yoshino and Miyamoto (2020) consider the portfolio choice of investors (households).¹ Investors choose an allocation between government bonds and investments to maximize their utility. The optimal allocation between government bonds and investments implies that the demand for government bonds depends on the difference between the interest rate of government bonds, the rate of return of investments, and the risk associated with government bonds and investments.

After taking the supply of government bonds into consideration, the modified Domar condition suggests that fiscal stability depends on the degree of sensitivity of the interest rates of both the demand and supply for government bonds. Both demand and supply curves are upward-sloping as in Figure 2. When the supply curve is steeper than the demand curve, to change government bond supply by one unit, the change in the interest rate of government bonds should be larger than the change in the interest rate from the demand side. This leads to explosion of budget deficits. When the demand curve is steeper than the supply curve, the opposite takes place.

The fiscal sustainability condition can be validated by examining the case of Greece and Japan (Yoshino and Miyamoto 2020). These two economies both have high debt-to-GDP ratios but differ in their fiscal sustainability, with the key difference being the demand for government bonds. While more than 90% of Japan's government bond is held by domestic investors, more than 70% of investors in Greece's bond market are foreigners. This high ratio of overseas investors was the cause of the increase in the interest rate of government bonds in Greece, which led to the Greek debt crisis.

¹ The portfolio choice problem of investors is similar to that of Yoshino, Taghizadeh-Hesary, and Otsuka (2020).

Figure 2: Modified Domar Condition

B = government bonds, D = demand, r = interest rate, S = supply, η = growth rate of economy.
 Source: Yoshino and Miyamoto 2020.

III. EXAMPLE OF DECENTRALIZED FISCAL SYSTEM

This paper extends the modified Domar model by adding the role of local government. In some countries that have adopted a highly decentralized administrative structure such as the PRC, where fiscal revenue and expenditure responsibilities are allocated across layers of administering bodies between the central and local governments, the sustainability of the system would be subject to various considerations.

A. Fiscal System

The PRC has a highly decentralized administrative structure with the central government and four administering bodies underneath. The first administrative body is the provincial level, which consists of 22 provinces, 5 autonomous regions, and 4 provincial municipalities. The second level consists of roughly 330 prefectures and municipalities. At the third level, there are roughly 2,850 counties; county-level cities; and urban districts. Finally, about 40,000 townships; and town and urban “neighborhoods” govern an average of about 35,000 people in each.

All units are governed by the Budget Law, but have an independent budget at their respective level, wherein each province determines its own revenue-sharing mechanism with municipalities under its jurisdiction. For each jurisdiction, the budget system is comprised of four categories: general public budget, government fund budget, state-owned budget, and social insurance fund budget. The general public budget is the main pillar. Although each budget is reported independently, there are transfers between budgets. In 2018, about 67% of central revenue was transferred to the local governments through central subsidy. Meanwhile, around 60% of the “social security and employment expenditure” in the general public budget is used to subsidize social security funds.

B. Fiscal Revenues and Expenditures

The fiscal revenue sources of central and local governments are different. The central government relies on income from taxes for its revenues, reaching almost 95% of total revenues in 2018, while local income taxes accounted for 78% of local government revenues. The central government receives tariffs, vehicle purchase, import, consumption, and corporate income taxes. Local governments taxes are mainly land-related, such as tax on land value and construction taxes. Nontax revenues of local governments are special and administrative incomes, and account for more than 20% of the total revenue (Table 1).

Table 1: Main Fiscal Revenue Items of Central and Local Governments, 2018
(hundred million)

Item	Central	Local	Total
Taxation Revenue	80,448.07	75,954.79	156,402.86
Domestic value-add tax	30,753.32	30,777.45	61,530.77
Domestic consumption tax	10,631.75		10,631.75
Import value-added tax	16,235.19		16,235.19
Import consumption tax	643.78		643.78
Export tax rebate	(15,913.93)		(15,913.93)
Corporation income tax	22,242.11	13,081.60	35,323.71
Personal income tax	8,324.42	5,547.55	13,871.97
Resource tax	45.15	1,584.75	1,629.90
Urban maintenance and construction tax	159.31	4,680.67	4,839.98
Building tax		2,888.56	2,888.56
Stamp tax	976.88	1,222.48	2,199.36
Urban land utilization tax		2,387.60	2,387.60
Increment tax on land value		5,641.38	5,641.38
Vehicle and vessel tax		831.19	831.19
Vessel tonnage tax	49.78		49.78
Vehicle purchase tax	3,452.53		3,452.53
Tariff	2,847.78		2,847.78
Cultivated land occupation tax		1,318.85	1,318.85
Deed tax		5,729.94	5,729.94
Tobacco tax		111.35	111.35
Environmental protection tax		151.38	151.38
Other tax revenue		0.04	0.04
Nontaxation revenue	5,008.39	21,948.59	26,956.98
Special income	325.95	7,197.44	7,523.39
Administrative income	404.56	3,520.89	3,925.45
Confiscation income	167.00	2,492.18	2,659.18
State-owned capital operating income	3,217.94	356.26	3,574.20
State-owned resources(assets) paid use income	789.00	6,286.87	7,075.87
Other income	103.84	2,094.95	2,198.79
Total	85,456.46	97,903.39	183,359.85

( ) = negative.

Source: National Bureau of Statistics of China. 2019. China Statistical Yearbook 2019.

<http://www.stats.gov.cn/tjsj/ndsj/2019/indexch.htm>.

On the expenditure side, there is a clear demarcation in responsibilities between the central and local governments as summarized in Table 2. The central government is responsible for maintaining national defense, armed police, and diplomatic and aid expenditures while local governments are tasked to pay for most of the social financing including basic education, medical care, environmental protection, and social security. In 2018, 85% of expenditures in the general public budget was carried out by local governments covering most of the social spending. This ratio has seen an increasing trend over the past decade driven by the rise in demand for a better life.

The transfer payment has two parts: general transfer payment and special transfer payment. The general transfer is to fill the financing gap in provinces that have weak fiscal revenue, and to deliver quality basic public services. The calculation of general transfer payment considers factors such as population and fiscal position. Special transfer payments refer to the subsidy funds set up by the central government to implement specific macro-policy and business developments, as well as to undertake projects entrusted by the central government. The special transfer payments are mainly used for public services under the direct control of the central government.

Table 2: Main General Public Budget Expenditure Item of Central and Local Governments, 2018
(hundred million)

Item	Central	Local	Total
General public service	1,503.68	16,871.01	18,374.69
Diplomacy	583.37	2.99	586.36
National defense	11,069.70	210.76	11,280.46
Public security	2,041.51	11,739.97	13,781.48
Education	1,731.23	30,438.24	32,169.47
Science and technology	3,120.27	5,206.38	8,326.65
Culture, sports, and media	281.13	2,356.73	2,637.86
Social security and employment	1,184.55	25,827.54	2,7012.09
Medical care and family planning	210.65	15,412.90	15,623.55
Energy saving and environment protection	427.56	5,870.05	6,297.61
Urban and rural communities	86.38	22,037.75	22,124.13
Agriculture, forestry, and water conservancy	592.30	20,493.29	21,085.59
Transportation	1,313.71	9,969.05	11,282.76
Resource exploration information, etc.	381.52	4,694.90	5,076.42
Business services	73.28	1,533.68	1,606.96
Finance	845.59	534.03	1,379.62
Assistance to other regions		442.16	442.16
Land and marine meteorology	353.67	1,919.91	2,273.58
House security	506.45	6,299.92	6,806.37
Grain and oil material reserves	1,375.65	685.11	2,060.76
Debt interest	4,161.65	3,241.07	7,402.72
Debt issuance expenses	37.23	22.98	60.21
Other	826.74	1,485.90	2,312.64
Total	32,707.81	188,196.32	220,904.13

( ) = negative.

Source: National Bureau of Statistics of China. 2019. China Statistical Yearbook 2019.

<http://www.stats.gov.cn/tjsj/ndsjsj/2019/indexch.htm>.

C. Filling the Fiscal Gap through Bond Issuance

In order to bridge the gap between limited financial resources and rising demand for capital investments, local governments have resorted to establishing and borrowing through local government financing platforms, particularly after the global financial crisis in 2008, to support the PRC's economic recovery.² Given the rapid accumulation of debt, however, reforms were instituted to keep the fiscal positions in check. In September 2014, a guidance, "*Opinions of the State Council on Strengthening Local Government Debt Management*" (State Council [43] 2014) was issued wherein the direct financing relationship between local government financing platforms and the local government was cut. Instead, a new version of the Budget Law was issued in 2014 that allowed local governments to issue bonds for financing.

² National Audit Office of the People's Republic of China. <http://www.audit.gov.cn/n5/n25/c63566/content.html>.

Local government bonds are classified into four types (Table 3):

- (i) General bonds are issued by local governments to make up for the fiscal deficit. The general bonds are recorded in the general public budget.
- (ii) Special bonds are for the construction of specific projects and are reflected in the government funds.
- (iii) R bonds are mainly used to roll over previously issued bonds.
- (iv) New bonds are mainly used to fund new projects of local governments. In the past few years, most of the issuance has been new bonds.

Despite the fact that fiscal conditions vary across provinces and the trading market is thin, bond prices have been historically stable and low. This is partly because the local governments have good bargaining power over commercial banks, which are the main holders of local government bonds. This trend has changed in recent years, however, with the completion of the replacement bond issuance.

Taking the 10-year general bonds issued by local governments in 2019 as an example, the issuance rate of local government bonds is somewhat affected by local economic and financial strength, i.e., the region with stronger economic and financial conditions manages to sell bonds with lower interest rates. In 2019, the average issuance rates of 10-year public bonds issued by local governments were relatively low at 3.35% (Beijing), 3.43% (Shanghai), and 3.48% (Ningbo). Meanwhile, 10-year bonds were issued at a relatively high levels of 3.77% (Guangxi Zhuang Autonomous Region), 3.59% (Guizhou Province), and 3.52% (Yunnan Province).

Table 3: Issuance of Local Government Bonds Since 2015
(trillion yuan)

Year	Public Issuance			Targeted Issuance	Total
	Replacement Bonds	New Bonds	Refinancing Bonds	Replacement Bonds	
2015	2.41	0.63		0.79	3.84
2016	3.30	1.17		1.58	6.05
2017	1.66	1.59		1.11	4.36
2018	0.91	2.17	0.68	0.41	4.17
2019	0.16	3.06	1.15		4.36

Source: China Bond Information Network. <https://www.chinabond.com.cn/>.

IV. THE MODEL: APPLICATION TO DECENTRALIZED FISCAL SYSTEM

This section examines how central government and local government can maintain fiscal sustainability in conducting fiscal policy.

A. The Model

The model consists of both demand for government bonds and supply of government bonds. In order to consider the demand for government bonds, we consider the portfolio choice of investors (households).³

³ The problem of investors' portfolio choices is similar to that in Yoshino, Taghizadeh-Hesary, Nakahigashi (2019) and Yoshino, Taghizadeh-Hesary, Otsuka (2020).

We assume that the utility function of investors depends on the rate of return r_t and risk σ_t as seen in equation (1):

$$U(r_t, \sigma_t) = r_t - \beta \sigma_t^2, \quad (1)$$

where β is the weight for risk. A larger β value implies that investors give more weight for risk.

Investors could purchase government bonds (both central and local) and invest into the market product. In equation (2), the rate of return on investment is denoted by r_t^I .

$$r_t = \alpha_C r_t^C + \alpha_L r_t^L + (1 - \alpha_C - \alpha_L) r_t^I, \quad (2)$$

where α_C and α_L are the share of central government bonds and local government bonds, respectively, and $(1 - \alpha_C - \alpha_L)$ is the share invested in market product.

The aggregate risk is expressed as follows:

$$\begin{aligned} \sigma_t^2 = & \alpha_C^2 (\sigma_t^C)^2 + \alpha_L^2 (\sigma_t^L)^2 + (1 - \alpha_C - \alpha_L)^2 (\sigma_t^I)^2 + 2\alpha_C \alpha_L \sigma_t^{CL} + 2\alpha_C (1 - \alpha_C - \alpha_L) \sigma_t^{CI} + \\ & 2\alpha_L (1 - \alpha_C - \alpha_L) \sigma_t^{LI}, \end{aligned} \quad (3)$$

By maximizing utility (1) subject to (2) and (3), the following allocation of central government bond and local government bond will be obtained:

$$\begin{aligned} \alpha_C = & \frac{\frac{r_t^C - r_t^I}{\beta} + 2(1 - \alpha_L)(\sigma_t^I)^2 - 2\alpha_L \sigma_t^{CL} - 2(1 - \alpha_L) \sigma_t^{CI} + 2\alpha_L \sigma_t^{LI}}{2(\sigma_t^C)^2 + 2(\sigma_t^I)^2 - 4\sigma_t^{CI}} \\ \alpha_L = & \frac{\frac{r_t^L - r_t^I}{\beta} + 2(1 - \alpha_C)(\sigma_t^I)^2 - 2\alpha_C \sigma_t^{CL} + 2\alpha_C \sigma_t^{CI} - 2(1 - \alpha_C) \sigma_t^{LI}}{2(\sigma_t^L)^2 + 2(\sigma_t^I)^2 - 4\sigma_t^{LI}} \end{aligned} \quad (4)$$

Then,

$$\begin{aligned} \alpha_C = & \frac{\frac{r_t^C - r_t^I}{\beta} + 2[(\sigma_t^I)^2 - \sigma_t^{CI}] + 2\alpha_L [-(\sigma_t^I)^2 - \sigma_t^{CL} + \sigma_t^{CI} + \sigma_t^{LI}]}{2(\sigma_t^C)^2 + 2(\sigma_t^I)^2 - 4\sigma_t^{CI}} \\ = & \frac{\frac{r_t^C - r_t^I}{\beta} + 2[(\sigma_t^I)^2 - \sigma_t^{CI}] + 2[-(\sigma_t^I)^2 - \sigma_t^{CL} + \sigma_t^{CI} + \sigma_t^{LI}]}{2(\sigma_t^C)^2 + 2(\sigma_t^I)^2 - 4\sigma_t^{CI}} \left\{ \frac{\frac{r_t^L - r_t^I}{\beta} + 2(1 - \alpha_C)(\sigma_t^I)^2 - 2\alpha_C \sigma_t^{CL} + 2\alpha_C \sigma_t^{CI} -}{2(\sigma_t^L)^2 + 2(\sigma_t^I)^2 - 4\sigma_t^{LI}} \right. \\ & \left. \frac{\frac{r_t^C - r_t^I}{\beta} + 2\Gamma + 2\Theta \left\{ \frac{\frac{r_t^L - r_t^I}{\beta} + 2(1 - \alpha_C)(\sigma_t^I)^2 - 2\alpha_C \sigma_t^{CL} + 2\alpha_C \sigma_t^{CI} - 2(1 - \alpha_C) \sigma_t^{LI}}{\Lambda} \right\}}{\Phi} \right\} \end{aligned} \quad (5)$$

where

$$\begin{aligned}
\Gamma &= (\sigma_t^I)^2 - \sigma_t^{CI} \\
\Theta &= -(\sigma_t^I)^2 - \sigma_t^{CI} \\
\Lambda &= 2(\sigma_t^L)^2 + 2(\sigma_t^I)^2 - 4\sigma_t^{LI} \\
\Phi &= 2(\sigma_t^C)^2 + 2(\sigma_t^I)^2 - 4\sigma_t^{CI}
\end{aligned} \tag{6}$$

Thus, we have

$$\alpha_C^* = \frac{\frac{r_t^C - r_t^I}{\beta} + 2\Gamma + 2\Theta \left\{ \frac{\frac{r_t^L - r_t^I}{\beta} + 2(\sigma_t^I)^2 - 2\sigma_t^{LI}}{\Lambda} \right\}}{\Phi + 4\Theta \left\{ \frac{(\sigma_t^I)^2 + \sigma_t^{CL} - \sigma_t^{CI} - \sigma_t^{LI}}{\Lambda} \right\}} \tag{7}$$

Equation (7) implies that the demand for government bonds depends on the difference between the interest rate of government bonds and the rate of return on investment ($r_t^B - r_t^I$) as well as the risk associated with government bonds and investment.

Thus, we have the following total demand function for government bonds, where the total demand function by domestic investors and foreign investors can be divided into two equations. The demand function for central government bonds by domestic investors (equation [8]) is given by;

$$\Delta B_{C,t}^d = b_0 + b_1(\sigma_t^C, \sigma_t^I)(r_t^C - r_t^I), \tag{8}$$

and the demand for foreign investors in central government bonds is given by equation (9) where risk premium (ρ) and exchange rate risk ($(e^e - e)/e$) are subtracted from the rate of interest on central government bond (r_t^C) when it is compared with the rate of return on foreign bond (r_t^f). The demand elasticity (f_1) is the function of risks of central government bond (σ_t^C), foreign government bond (σ_t^f), and risk premium (ρ):

$$\Delta B_{C,t}^f = f_0 + f_1(\sigma_t^C, \sigma_t^f, \rho) \left\{ (r_t^C - \rho - \frac{e^e - e}{e}) - r_t^f \right\}. \tag{9}$$

The demand function for local government bonds depends on interest rate gap between local government bond (r_t^L) and market investment (r_t^I) where the coefficient b_1 (the interest rate sensitivity) depends on risks of local government bond (σ_t^L) and market investment (σ_t^I).

$$\Delta B_{L,t}^d = b'_0 + b'_1(\sigma_t^L, \sigma_t^I)(r_t^L - r_t^I), \tag{10}$$

Similarly, the investment function is obtained by taking into consideration market investment as shown in equation (11).

$$I_t^d = i_0 + i_1(\sigma_t^B, \sigma_t^I)(r_t^B - r_t^I). \tag{11}$$

B. Supply of Government Bonds

The supply of central government bonds is described by the central government budget constraint shown in equation (12):

$$G_{C,t} + r_t^C B_{C,t-1}^S + TRN = \Delta B_{C,t}^S + T_{C,t} + \Delta M_t, \quad (12)$$

where TRN is transfer to the local government, ΔM_t is the supply of money that is printed when government bonds are purchased from the market in an open market operation. Equation (12) expresses the central government budget constraint where the left-hand side is total government expenses, which include central government spending (G_c), interest payments on government bonds ($r_t^C B_{ct-1}^S$), and transfers from the central government to local government (TRN). The left-hand side of equation (12) is the issue of central government bond ($\Delta B_{c,t}^S$), Central government tax revenues (T_{ct}) and money supply (ΔM_t) show the central government bonds purchased by the central bank.

Similarly, the local government budget constraint is given by

$$G_{L,t} + r_t^L B_{L,t-1}^S = \Delta B_{L,t} + T_{L,t} + TRN + NTR, \quad (13)$$

where the left-hand side of equation (13) is local government spending ($G_{L,t}$) and interest payment of local government bond. The right-hand side of equation (13) shows the new issue of local government bond ($\Delta B_{L,t}$), local government tax revenues ($T_{L,t}$), transfer from the central government to local government (TRN), and nontax revenues (NTR) of local government.

From equation (8) (demand for central government bond by domestic investors), equation (9) (demand for central government bond by foreign investors), and equation (12) (supply of central government bond), we have the equilibrium interest rate of central government bonds as follows:

$$r_t^{C*} = \frac{-G_{C,t} + T_{C,t} - TRN + \Delta M_t + b_0 - b_1(\sigma_t^C, \sigma_t^I) r_t^I + f_0 + f_1(\sigma_t^C, \sigma_t^f, \rho) \left\{ -\rho - \frac{e^e - e}{e} - r_t^f \right\}}{B_{C,t-1}^S - b_1(\sigma_t^C, \sigma_t^I) - f_1(\sigma_t^C, \sigma_t^f, \rho)}. \quad (14)$$

Similarly, from equation (10) (local government bond demand) and equation (13) (supply of local government bond), the equilibrium interest rate for the local government bonds is given by the following equation.

$$r_t^{L*} = \frac{b_0' - b_1'(\sigma_t^L, \sigma_t^I) r_t^I - G_{L,t} + T_{L,t} + TRN + NTR}{B_{L,t-1}^S - b_1'(\sigma_t^L, \sigma_t^I)} \quad (15)$$

C. Market Equilibrium in Goods and Services Market

The disposable income Y_t^D is income Y plus the interest from the government bond minus tax payments. As the disposable income is divided into consumption C_t and savings S_t , we have

$$Y_t^D = Y_t + r_t^B B_{t-1} - T_t = C_t + S_t. \quad (16)$$

As discussed above, households save through purchasing government bonds and investment. Thus, we have

$$S_t = \Delta B_t^d + I_t^d. \quad (17)$$

We assume that consumption depends on disposable income, interest rate of government bonds, rate of return on investment, and risk associated with government bonds and investment.

$$C_t = c_0 + c_1 Y_t^D + c_2(\sigma_t^B, \sigma_t^I)(r_t^B - r_t^I). \quad (18)$$

Substituting equation (17) into (16), the following equation will be obtained:

$$Y_t = T_t - r_t^B B_{t-1} + C_t + \Delta B_t^d + I_t^d. \quad (19)$$

As $Y_t = C_t + I_t + G_t$, in equation (19), we have

$$Y_t = C_t + I_t + G_t = T_t - r_t^B B_{t-1} + C_t + \Delta B_t^d + I_t^d. \quad (20)$$

With the equilibrium interest rate r_t^{B*} , the equilibrium income is

$$Y_t^* = \frac{1}{1 - c_1} \{c_0 + c_1[-T_t + r_t^B B_{t-1}] + c_2(\sigma_t^B, \sigma_t^I)(r_t^B - r_t^I) + i_0 + i_1(\sigma_t^B, \sigma_t^I)(r_t^B - r_t^I) + G_t\}. \quad (21)$$

Note that instead of using the liquidity preference-money supply (LM) curve, this model uses the equilibrium condition of the bond market, which is often called BB curve. Thus, our framework is the investment-savings-bond market equilibrium (IS-BB) model.⁴

D. Revised Domar Condition for Central Government Bonds

By substituting equation (14) into (12), we have the equilibrium value of central government bond.

$$\Delta B_{C,t} = G_{C,t} + r_t^{C*} B_{C,t-1} + TRN - T_{C,t} - \Delta M_t. \quad (22)$$

This yields the changes in the amount of central government bond ($\Delta B_{C,t}$) when the stock of central government bond ($B_{C,t-1}$) rises, as shown in equation (23).

$$\frac{\partial \Delta B_{C,t}}{\partial B_{C,t-1}} = \frac{\partial r_t^{C*}}{\partial B_{C,t-1}} B_{C,t-1} + r_t^{C*}, \quad (23)$$

where

$$\frac{\partial r_t^{C*}}{\partial B_{C,t-1}} = - \frac{r_t^{C*}}{B_{C,t-1} - b_1 - f_1}, \quad (24)$$

Thus, we have

$$\frac{\partial \Delta B_{C,t}}{\partial B_{C,t-1}} = \left(\frac{1}{1 - \frac{B_{C,t-1}}{b_1 + f_1}} \right) r_t^{C*}. \quad (25)$$

⁴ Stiglitz and Weiss (1981) use a similar framework to analyze credit rationing.

This implies

$$\frac{\partial \Delta B_{c,t}}{\partial B_{c,t-1}} \geq 0 \Leftrightarrow 1 \geq \frac{B_{c,t-1}}{b_1 + f_1} \quad (26)$$

This result of equation (26) can be interpreted as follows. When the existing stock of central government debt increases (δB_{ct-1}), the interest payment of the central government will rise. The supply curve of government bond will shift to the right to finance increased interest payments. If the shift of the supply curve brings in higher interest rates for central government bonds, the budget deficits will increase further. Explosion of budget deficits will occur (left-hand side of Figure 3).

On the other hand, an increase of the stock of government bonds (δB_{ct-1}) that shifts the supply curve to the right will bring lower interest rates (right-hand side of Figure 3), and the budget deficits converge to a stable level.

In other words, the steeper the slope of government bond supply compared to the demand for central government bond, i.e., $1/B_{ct-1} > 1/(b_1 + f_1)$, the higher the interest rate, which will lead to explosion of the budget deficit. The left-hand side of Figure 3 will show an increase in interest rate from 0 to 1.

If the slope of the government bond supply compared to the demand for central government bond is flatter, i.e., $1/B_{ct-1} < 1/(b_1 + f_1)$, the rate becomes smaller and smaller, which will lead to stability of the budget deficits. The right-hand side of Figure 3 will show a decline in interest rate from 3 to 4.

E. Revised Domar Condition for Local Government Bonds

We now turn to see the local government case. By substituting (15) into (13), we have

$$G_{L,t} + r_t^{L*} B_{L,t-1}^S = \Delta B_{L,t}^S + T_{L,t} + TRN + NTR \quad (27)$$

where the left-hand side of equation (27) is local government spending ($G_{L,t}$) and interest payment of local government bonds. The right-hand side of equation (27) shows the new issue of local government bonds ($\Delta B_{L,t}^S$), local government tax revenues ($T_{L,t}$), transfers from the central government to local government (TRN), and nontax revenues (NTR) of local government.

This yields equation (28)

$$\frac{\partial \Delta B_{L,t}}{\partial B_{L,t-1}^S} = r_t^{L*} + \frac{\partial r_t^{L*}}{\partial B_{L,t-1}^S} B_{L,t-1}^S \quad (28)$$

where

$$\frac{\partial r_t^{L*}}{\partial B_{L,t-1}^S} = \frac{b'_0 - b'_1(\sigma_t^L, \sigma_t^I)r_t^I - G_{L,t} + T_{L,t} + TRN + NTR}{(B_{L,t-1}^S - b'_1(\sigma_t^L, \sigma_t^I))^2} = -\frac{r_t^{L*}}{B_{L,t-1}^S - b'_1} \quad (29)$$

Then, we have

$$\frac{\partial \Delta B_{L,t}}{\partial B_{L,t-1}^S} = r_t^{L*} \left[\frac{1}{1 - \frac{B_{L,t-1}^S}{b'_1}} \right] \quad (30)$$

This implies

$$\frac{\partial \Delta B_{L,t}}{\partial B_{L,t-1}^S} \geq 0 \Leftrightarrow 1 \geq \frac{B_{L,t-1}^S}{b'_1} \quad (31)$$

The result in equation (31) can be interpreted as follows. When the existing stock of local government debt increases ($\delta B_{L,t-1}$), interest payments of the local government will rise. The supply curve of local government bonds will shift to the right to finance increased interest payments. If the shift of the supply curve of local bonds brings in higher interest rates for local government bonds, there will be an explosion in the budget deficit (left-hand side of Figure 4).

On the other hand, an increase in the supply of local government bonds ($\delta B_{L,t-1}$) that shifts the supply curve to the right will bring lower interest rates (right-hand side of Figure 4), and the budget deficits converge to a stable level.

In other words, the steeper the slope of local government bond supply compared to the demand for local government bond, i.e., $1/B_{L,t-1} > 1/(b'_1)$, the higher the interest rate, which will lead to explosion of the budget deficits of the local government. The left-hand side of Figure 4 shows an increase in interest rate from 0 to 1.

If the slope of local government bond supply compared to the demand for local government bond is flatter, i.e., $1/B_{L,t-1} < 1/(b'_1)$, the smaller the interest rate on local government bond, which will lead to stability in the budget deficits. The right-hand side of Figure 4 shows a decline in interest rate from 3 to 4.

Figure 4: Local Government Bond Market—Revised Fiscal Stability Condition

B = government bonds, D = demand, r = interest rate, S = supply, η = growth rate of economy.
Source: Authors.

F. Examining Fiscal Sustainability in the Case of the People's Republic of China

The fiscal conditions and related laws in both central and local governments have evolved over time. This section examines the fiscal sustainability of both central and local governments following Yoshino and Miyamoto (2020).

(i) Central Government Bonds

Data for government bonds were available from the second quarter (Q2) of 1997 to Q4 2019 while government bond price data started only from Q2 2005. Our sample period includes all datapoints where data for bond outstanding and price are both available.⁵ Figure 5 plots the bond yields of total and local government bonds. The local bonds are priced slightly higher compared to total government bonds.

Following Yoshino and Miyamoto (2020), we evaluate the time variation in the relationship between current yield and the lagged outstanding government bonds, b_t . We ran equation (32) as specified below:

$$\Delta B_{t-1} = b_0 + b_1 r_t^B + e_t \quad (32)$$

where e_t is the error term. All possible 8 years' subsamples from the beginning of the full sample were included, sequentially moving by one time period.

⁵ Data for government bonds outstanding and bond prices are taken from Chinabond, Wind Information, and Bloomberg LP. The data for total government bonds outstanding is the sum of treasury bonds and bills, savings bonds, local government bonds, central government bonds, and policy bank bonds, which are issued by the Agricultural Development Bank of China, China Development Bank, and Export-Import Bank of China. Bond price data were the China Govt Bond Generic Bid Yield 5Y for total government bond, and ChinaBond Fixed-Rate Local Government Bond Yield Curve (AAA-) 5Y YTM for local bonds.

Estimation results show that the bond price is negatively related to lagged bond volume, but not significant in any level of significance. The time series for B_{t-1} and the estimated interest rate sensitivity or b_1 are presented in Figure 6. The results largely satisfy the stability condition of $B_{t-1} > b_1$, except for a few the periods when the estimated b_1 was higher than the outstanding government debt in Q1 2009, Q4 2010, and Q1 2011.

While the b_1 estimate breached the value of lagged outstanding government bonds during those periods, note that these are brief and discrete, often returning to stable conditions in the immediate succeeding quarters. Hence, the instability phases were temporary and nonalarming. It can be recalled that these periods coincided with the massive fiscal spending the PRC undertook and the public investments to fight recession following the 2008 global financial crisis; therefore, excess borrowings were utilized in productive capacities rather than as one-off benefits (in the case of too much government subsidies).

The results show that the fiscal condition of the PRC is largely sustainable. This can be attributed to the fact that a large chunk of the PRC central government bonds was held by local investors (84% in 2018/2019), and a little over 4% are held by foreign investors, ensuring a stable bond price.

(ii) Local Government Bonds

While treasury bonds and policy bonds dominated bond issuances accounting for more than 75% of the total, local government bonds became more mainstream in 2015 (Figure 7). As of Q4 2019, local government bonds account for about 40% of outstanding total government bonds. With support from the State Council, more and more local governments resort to issuance of local government bonds to support effective investment and major infrastructure projects such as railways, road, and water conservation to spur development and regeneration in their local economies.

Figure 7: Government Bonds by Composition, 1997–2019
(%)

Note: Authors' calculations.

Local bonds outstanding and price data are both available starting in 2015. Due to limited data availability, only a point estimation was conducted. Results show that the bond price is still negatively related to lagged bond volume, and more importantly, satisfies the stable condition of $B_{t-1} > b_1$ all throughout the sample period (Figure 8). This confirms that despite the increased bond issuances of local governments, yield prices are still favorable and implies budget stability for local governments in the PRC.

Figure 8: Local Government Bonds

b_1 = interest rate sensitivity, $b_{tgp} = b_1$ estimate for total government bonds, $tgb(t-1)$ = lagged outstanding government bonds.
Source: Authors' calculations.

V. FACTORS AFFECTING INTEREST RATE SENSITIVITY

A natural question that arises is what factors make $b1$ or interest rate sensitivity rise. Yoshino and Miyamoto (2020) examine the validity of our fiscal sustainability condition by looking at the case of Greece and Japan as they both have high debt-to-GDP ratio but differ in their fiscal sustainability. While Greece went bankrupt, Japan's fiscal position is still sustainable—although Japan's debt-to-GDP ratio is higher than that of Greece. They claim that the key difference between Greece and Japan is the demand for government bonds. While more than 90% of Japan's government bonds is held by domestic investors, more than 70% of investors in Greece's bond market were foreigners. This high ratio of overseas investors was the cause of the increase in the interest rate of government bonds in Greece, which led to the Greek government debt crisis as overseas investors started to leave the Greece bond market by selling their Greece bonds. The share of overseas investors affects the stability of the government bond market.

In the case of the PRC, both central and local government bond markets appear stable for now as discussed in the previous section. Its local bond market primarily consists of domestic investors, although for the central government bonds about 4.5% are foreign investors—about the same as in Japan (Table 4).

Table 4: Investors in Government Bonds in the People's Republic of China

Central government bonds (% of total)	2019	Local government bonds (% of total)	2019
Interbank Market	50.00	Interbank Market	58.38
Commercial Bank	33.84	Commercial Bank	51.44
Other	5.31	Policy Bank	4.74
Foreign Investor	4.45	Unincorporated Product	1.17
Unincorporated Product	3.73	Insurance Company	0.38
Insurance Company	1.23	Trust Cooperative	0.35
Securities Company	0.57	Securities Company	0.24
Policy Bank	0.36	Other Financial Institution	0.05
Trust Cooperative	0.32	Foreign Investor	0.01
Other Financial Institution	0.17	Other	0.00
Fund Company and Foundation	0.02	Fund Company and Foundation	0.00
Nonfinancial Institution	0.00	Nonfinancial Institution	0.00

Source: <https://asianbondsonline.adb.org/data-portal/>.

VI. THRESHOLDS IN THE SHARE OF OVERSEAS INVESTORS IN GOVERNMENT BOND MARKETS

There is always a question concerning demand for government bonds, as to how much could be owned by overseas investors. Theoretically, it can be shown how quickly overseas investors move out of bond markets by selling government bonds in exchange for safer assets in times of crisis. Equation (33) shows the adjustment speed of the government bond market adding both domestic investors and overseas investors.

$$\dot{\alpha} = \dot{\alpha}_d \left(\frac{D}{D+F} \right) + \dot{\alpha}_F \left(\frac{F}{D+F} \right) \quad (33)$$

where $\dot{\alpha}$ = movement speed of total government bond

$\dot{\alpha}_d$ = movement speed of domestic investors

$\dot{\alpha}_F$ = movement speed of foreign investors

$D/(D+F)$ = share of domestic investors

$F/(D+F)$ = share of foreign investors

The movement speed of investors out of bond markets depends on expected risks associated with government bonds and other safer assets. If we assume that foreign investors react 10 times faster than domestic investors, i.e., $\dot{\alpha}_F > 10 \times \dot{\alpha}_d$, the share of foreign investors has to be lower than 10% in the market. Foreign investors can flee government bonds by selling the bonds in case of an impending crisis, despite various measures that may be taken by the central bank and the government.

Therefore, the optimal share of overseas investors would rely on the speed of movement out of bond markets by foreign investors compared to domestic investors. In the early stage of bond market development, foreign investors' participation in the market will help develop the bond market; however, their share must be within a certain ratio depending on their speed of movement in the market.

VII. CONCLUSION

This paper extends Yoshino and Miyamoto (2020) by introducing the characteristics of fiscal decentralization. Many countries such as the PRC adopt a heavily decentralized fiscal system, which complicates the analysis of fiscal sustainability. In the PRC, much of public social spending lies on local governments, while revenue allocation is heavily skewed toward the central government. While there is a transfer scheme between central and local governments to fill the void, many local governments are increasing the issuance of bonds to finance their needs. Hence, understanding the sustainability of the local government fiscal system is critical.

In this paper, budget stability in both the central government and local governments are examined. In both cases, we find that the conditions for the stability of the budget deficits relies on the difference in interest sensitivity of supply and demand. In the case of the central government, it is assumed that the demand comes from not only domestic investors but also foreign investors. In the local bond market, demand is restricted to domestic investors.

If the slope of the bond supply is steeper than the demand for bonds, interest rates will keep on rising as bond issuance rises. As a result, budget deficits, including interest payments on the debt will be higher and higher, which will bring about an explosion of the budget deficit. On the other hand, if the slope of the bond supply is lower than the demand for bonds, interest rates will fall. Budget deficits including interest payments will become smaller and smaller until the budget deficits converge and remain stable.

The Domar condition compares interest rate and the growth rate of the economy. It is applicable to the United States, where the investor base is broad and demand is stable. However, this is not the case for countries such as the PRC, Japan, and other Asian countries where bond issuance is in the local currency, and where the investor base is limited. Both supply of government bonds and the demand for government bonds must be taken into account.

The case of the PRC suggests that the bond markets, both in central and local government bonds, appear stable for now. However, transfers from the central government to local governments will temporarily delay the explosion of the budget deficit and will not solve the stability of the budget deficit. Both the central government and local governments must pay attention to the amount of existing debt in comparison to the interest rate sensitivity of demand for government bonds.

Finally, foreign investor participation in government bond markets will help to develop the market. However too large a share of overseas investors will increase volatility of the bond market, depending on the speed of movement of overseas investors in comparison to domestic investors.

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Public Debt Stability in the People's Republic of China

Rethinking the Domar Condition and Its Bond Market Application

This paper extends the supply side argument of the Domar model for fiscal sustainability. The authors find that public debt sustainability depends on the sensitivity of interest rates to changes in government bond supply and demand. This is true in the case of the People's Republic of China, Greece, and Japan. This modified fiscal sustainability condition suggests that the opening of capital markets to nonresident investors is important together with stability of the bond market. The opening, however, needs to be done cautiously and must consider how quickly overseas investors can move away from the market compared to domestic investors.

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